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A MINIMUM STANDARD FOR X-RAY SERVICE IN A HOSPITAL [1]

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FIRST, I beg to call to your attention the fact that at this meeting last year I was privileged to address you on the "Fundamental Requirements of an Efficient X-ray Service in Hospitals." At that time, feeling that we were discussing minimum requirements, I tried to put into as concrete form as possible a statement of the minimum equipment, space, organization, personnel, and recording service, together with a discussion on the interpretation of findings. It did not seem possible then, nor does it now, to attempt an ironclad itemizing of the various articles of equipment, for these will vary within certain limits according to the size of the hospital and the activity of the outpatient department.

We have observed some very interesting conditions. For example, there are instances where a bequest has been given to a small hospital with the specification that it be expended on the X-ray department, with the result that the X-ray service possesses instruments altogether beyond the needs of the hospital or of the community or of the ability of the personnel of the hospital to employ, leaving other departments of the hospital without adequate material. More often we have found the X-ray department still cooped up in the same small space occupied ten or fifteen years ago by the photographic and the primitive roentgen apparatus of those days, without provision for the tremendous expansion which this department of hospital service has undergone within recent times. For those who are definitely interested in the topic of this paper, I would respectfully suggest a re-reading of my talk of a year ago, as printed on pages 82 to 86 of the Report of the Hospital Conference held at Chicago, October 22 and 23, 1923 (*Bulletin of the American College of Surgeons*, 1924, VIII: No. 1, January, also published in the *Journal of the American Medical Association*, 82:2071 (June 21), 1924).[2]

For this discussion permit me to take up somewhat in detail the paragraph under "Hospital Standardization Explained," relating to the X-ray Department, found in this year's Hospital Standardization Report of the American College of Surgeons.

The opening sentence declares that "*like the clinical laboratory, the X-ray department is also essential in every hospital.*" If we may depend upon the judgment of Dr. Richard Cabot, as expressed in a recent address before the American Roentgen Ray Society, there can be no question as to the correctness of this statement. Dr. Cabot, basing his statement upon the results of many hundreds of pathological conferences of the type well known to us all, where the ultimate value of the various laboratory and clinical findings comes to an impartial appraisal, asserted that the roentgen find-

[1] Read at the Hospital Conference held at New York, October 20 and 21, 1924, by the American College of Surgeons.

[2] Anyone desiring a copy of this reprint may obtain one by addressing the writer of this article.

ings were often more valuable than combined reports from the clinical laboratories; then he went on to place both of them in their relative positions with regard to the history and the physical examination.

"*It should have the necessary space, be properly lighted and ventilated, and conveniently located to the professional services.*" There is one other consideration which should be more than implied, namely, that of protection. The provision of proper protection will automatically care for some features of the items "space, ventilation, and location." I cannot do better here than to invite your attention to the work of the Safety Committee of the American Roentgen Ray Society, which from time to time reports on various phases of the protection question. The last published report appears in the *American Journal of Roentgenology and Radium Therapy* for March, 1923, pages 240 to 245 and 246 and 247. Following is a summary of the last published report made by the Safety Committee:

1. X-ray equipment should not be installed or operated in low-ceiling rooms with overhead piping, or in damp or poorly ventilated rooms.
2. Floors should be covered with cork or other insulating material.
3. Foot switches should not be used in any radiographic work.
4. All diagnostic operating switches should automatically and positively open when released.
5. Double scale milliamperemeters should be eliminated.
6. Two milliamperemeters in series should be used in treatment.
7. All X-ray apparatus should be equipped with quick-acting circuit breakers, preferably of double pole type. These should open with certainty on a 20 per cent overload. Circuit breakers should be tested at least once a month and a permanent record kept of these tests. Properly rated fuses should be used in addition to circuit breakers.
8. Where overhead high-tension lines are used they should be of metal tubing not less than ½ inch in diameter. They should be firmly mounted and extend to the transformer or rectifier terminals.
9. High-tension reel wire should be of fine braided enameled copper without cloth covering, strong enough to stand a pull of not less than 50 pounds weight.
10. High-tension reels should be firmly mounted and have proper winding guides to prevent catching when winding, and sufficient tension to wind up against a pull of one pound weight.
11. Vertical and horizontal fluoroscopes should be so enclosed by insulating materials as to prevent operator, patient, or assistants from approaching within sparking distance of any part of the high-tension system. Metal screens should not be used if the fluoroscope table permits the use of a tube over the patient.
12. In every installation the operating switch should be so placed that a full and unobstructed view is had of the high-tension line to be used. If lead glass windows are provided, they should be large enough to insure such a view.
13. All tables used for treatment with the patient between the tube and the table should be made of insulating material, unless the tube and terminals are enclosed in a permanent grounded case. No spring mattresses should be allowed.
14. Tables used for radiographic and fluoroscopic work should be of insulating material when practical, and the handles of all switches and diaphragm controls should be of such material.
15. Where tubes in more than one room or booth are to be operated from the same transformer, provision should be made so as to make impossible simultaneous operation or closure by anyone not in direct charge of the tube or line used. This may readily be accomplished by suitable interlocking switches or otherwise.
16. All bedside or portable outfits should have their high-tension lines so placed that they permit of doing bedside

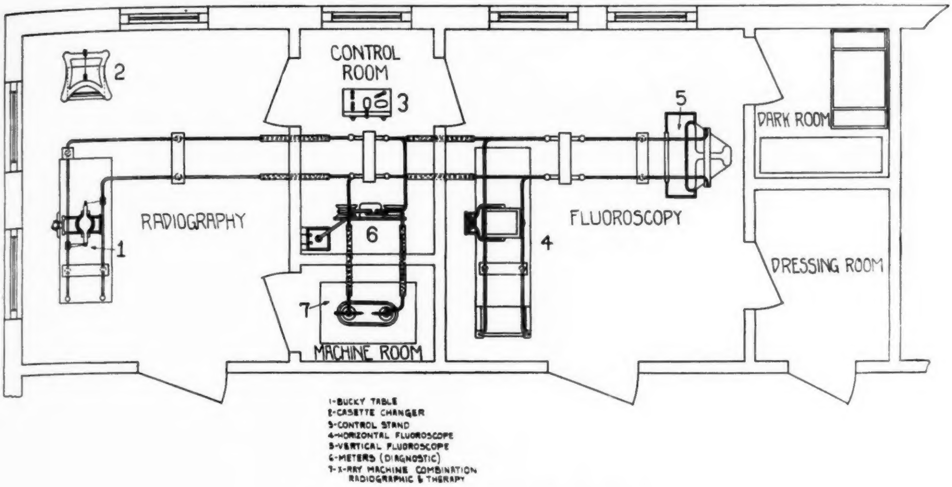

Fig. 1. Layout for a hospital of 50 beds.

work without having their wires come nearer to the patient than the tube terminals.

17. No treatment apparatus should permit any part of the high-tension system to come closer to the patient than double the operating spark-gap unless protected by a suitable insulator.

18. Permanently placed grounded metal screens between the tube and the patient are permissible and advised where the spark-gap exceeds ten inches.

19. Machines for high-voltage therapy should be so designed that their milliamperage on a short arc discharge is not more than 50 milliamperes.

It would be wise for every hospital to review the conditions in the X-ray department with reference to this safety question. The matter of filing of X-ray films should also receive careful consideration unless the non-inflammable variety of films is used. There is a serious fire-risk in every file of the ordinary highly inflammable X-ray films, unless properly protected and ventilated filing cabinets are provided.[3]

The figures submitted in my last report concerning the minimum floor space required by the X-ray department seem to meet the approval of a considerable number of well-known radiologists to whom I have submitted the question. I repeat them. Understand, these figures are minimum, not optimum.

Hospital of 50 beds, at least 400 square feet of floor space.

Hospital of 100 beds, at least 650 square feet of floor space.

Hospital of 150 beds and up, at least 1,200 to 3,000 square feet of floor space.

If the hospital in question is a teaching hospital, then still more space must be provided as a minimum requirement.

"It should be organized and equipped to do radiographic and fluoroscopic work at least. Superficial and deep therapy is advisable where possible and practical." The matter of intensifying screens is of no small importance. The initial outlay for screens is fairly expensive, but their careful and economical use leads to a very great saving in tubes and a very marked improvement in the quality of those exposures which must be done more or less instantaneously to be of value.

At the request of the Director-general of the American College of Surgeons, a committee was appointed in June, 1924, by President G. E. Pfahler, of the American College of Radiology, to offer to the Board of Regents of the College a list of minimum

[3] A description of the proper construction of such a cabinet will be sent anyone who will address the writer of this paper.

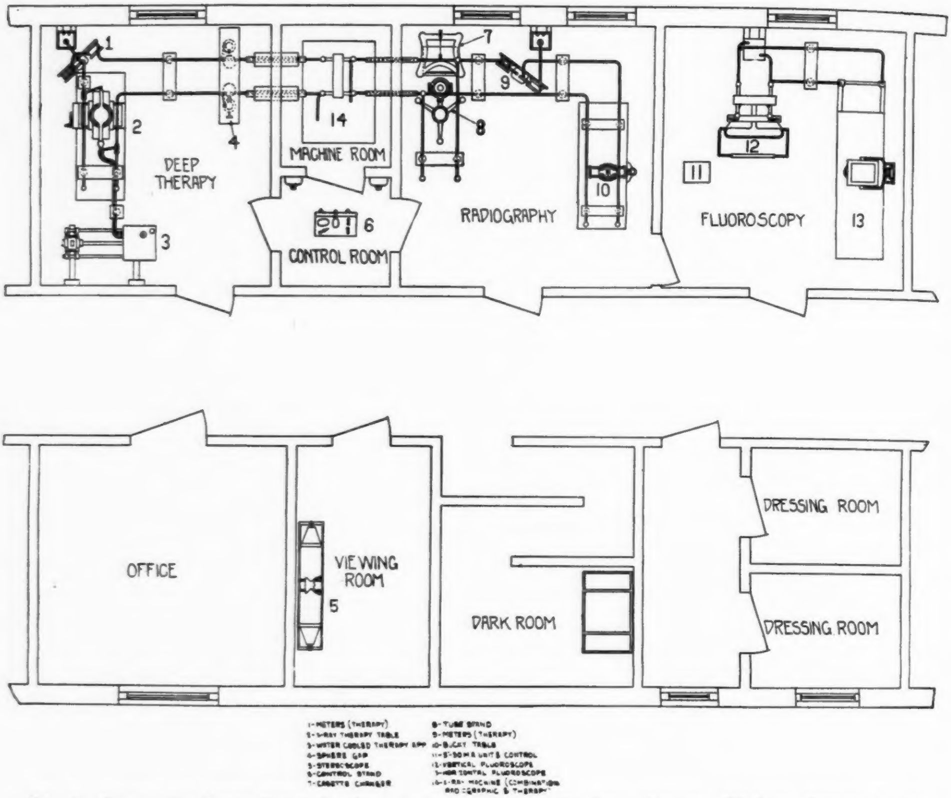

Fig. 2. Layout for larger hospital, where it is intended to do deep therapy. If deep therapy is not being undertaken, then some modification can be made in the distribution of the instruments.

apparatus and equipment requirements for a standardized hospital of 50 beds or over. The following standard has been offered to the Board of Regents. It should not for one moment be understood that this is anything more than a minimum; and the requirements for a hospital of 100 beds and up should be considerably higher.

MINIMUM EQUIPMENT FOR HOSPITALS OF 50 TO 100 BEDS

In at least 400 square feet of floor space, properly lighted and ventilated, free from dampness and otherwise properly protected from electrical and X-ray dangers, and conveniently located in relation to the professional services, there should be placed at least the following:

One interrupterless transformer, of 5 K.W. or more capacity, with both rheostat and auto-transformer control, and preferably with 2 milliamperemeters.

Coolidge tubes, of universal and radiator type.

Upright and horizontal fluoroscope and X-ray table equipped with tubestand, or a combination tilt table with facilities for fluoroscopic and radiographic work above and below the table and in the vertical position.

One Potter-Bucky diaphragm, preferably attached permanently to the X-ray table.

Upright plate changer for stereoscopic chest work (this also may be incorporated in the combination table).

Tunnel plate changer for ordinary stereoscopic work.

Stereoscope and viewing box.

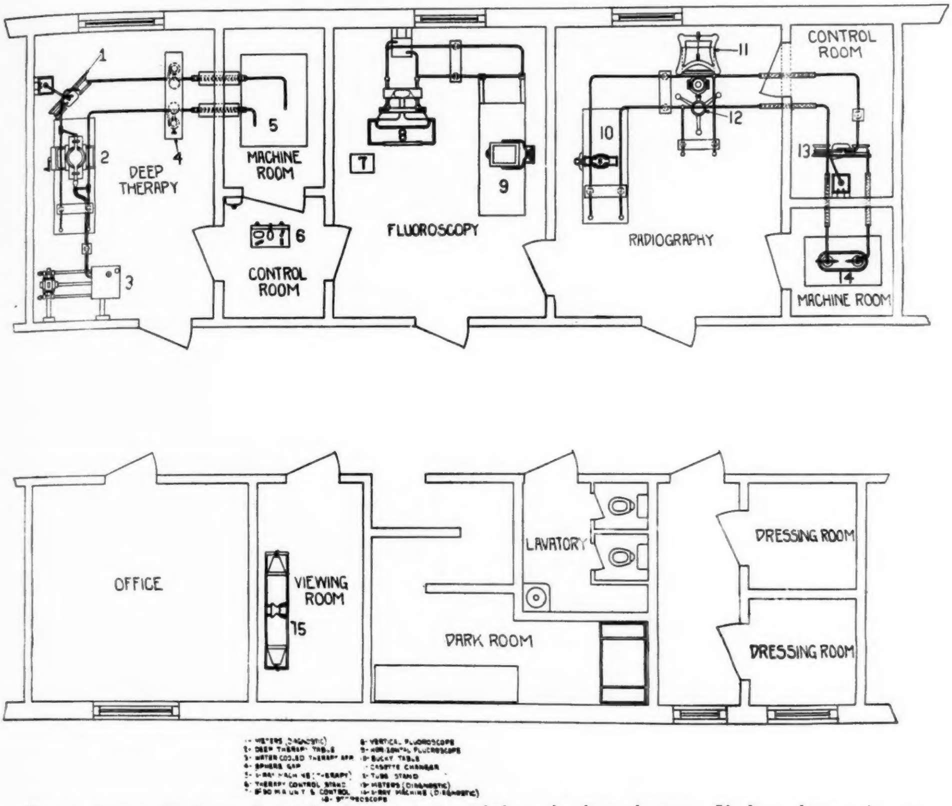

Fig. 3. Layout for larger hospital, where it is intended to do deep therapy. If deep therapy is not being undertaken, then some modification can be made in the distribution of the instruments.

Two or more cassettes of each of the following sizes: 8x10 inches, 10x12 inches, and 14x17 inches, with permanently attached intensifying screens.

One set of dark-room equipment.

Lead rubber protective gloves, aprons, goggles, time clock, and minor accessories.

MINIMUM EQUIPMENT FOR HOSPITALS OF 100 BEDS AND UP

A more powerful interrupterless transformer than above noted.

Where therapeutic work is approved and a properly trained medical radiologist is available, 200,000-volt X-ray equipment for deep therapy may be added.

A minimum of 650 square feet of floor space.

Table with Potter-Bucky diaphragm permanently attached is highly desirable.

Intensifying screens: 6 cassettes 8x10 inches, 6 cassettes 10x12 inches, and 4 cassettes 14x17 inches, all double and permanently attached.

Eye localizer and charts.

Fluoroscopic bonnet for foreign body and fracture manipulations necessary in operating room.

The committee was not asked to report on any other phases of the radiological service than the equipment.

As for X-ray therapy, it is useless and positively dangerous to undertake it unless the physician in charge of the department has had special training in therapeutic applications of the X-ray. For those hospitals not yet able to provide a physician for this work, X-ray therapy should not be undertaken at all.

The provision of a portable or bedside unit is one too little appreciated in most hospitals. This unit may be in such form that it can be used for work outside of the hospital,—in the home, wherever electrical current is available. Too much fracture work is done in the home without X-ray control.

Three drawings are submitted herewith which are intended to be practical suggestions for layouts for a roentgen department in a hospital.

"Supervision Through a Medical Roentgenologist Is Essential"

The American College of Surgeons has made a very important forward move in incorporating this statement in the minimum standard. This supervision by a physician roentgenologist is discussed at some length in my paper of last year, already referred to, but we may with profit once more emphasize that this supervision is necessary not only from the standpoint of administration and the carrying on of complicated technic, but particularly on account of the interpretation of findings which can be properly done only by such a trained person. Even in those small communities where it is as yet impossible to find a man specializing in roentgenology to take charge of the hospital X-ray work, it is quite feasible for the members of the staff to pool their interests and select one of their number to devote special attention to this matter, and take definite steps to improve his ability to interpret X-ray findings. As already mentioned, it is out of the question to consider the matter of X-ray treatment by anyone not a physician, and no physician in his right mind will dare to undertake X-ray therapy unless he has had special training in this work. Otherwise one of two things is almost sure to happen: either he will lean so far to the safe side that his therapeutic endeavors will have little or no effect, or else he will damage enough patients to shortly put an end to his therapeutic essays.

ROENTGEN-RAY STUDY OF 926 CASES OF RICKETS[1]

By T. A. GROOVER, M.D., A. C. CHRISTIE, M.D., and E. A. MERRITT, M.D., WASHINGTON, D. C.

INTRODUCTION

A SATISFACTORY and complete study by the roentgen rays of a large number of young children for the purpose of establishing the presence of rickets in any of its various stages, presents great difficulties.

The one valuable lesson learned by our experience in the cases included in this report is the imperative need of special apparatus, first-class accessories and highly trained assistants whose patience will stand the onslaught of unwilling and ofttimes incorrigible subjects.

Having accomplished the work in a more or less satisfactory manner we are better prepared to take it up again when circumstances warrant, or to advise those who are about to begin.

The roentgenogram is, of course, a highly satisfactory and unique record of specific bone lesions and by itself furnishes a tangible diagnosis in any stage of this disease. Indeed, it may and frequently does furnish the only basis for an opinion in incipient rickets. A satisfactory roentgenogram, which may require unusual effort and patience to secure, will invariably register bone character and morphological changes in a most exacting manner, equalled, perhaps, but not always surpassed by a histological section.

TECHNIC

Having briefly referred to the difficulties encountered in the study of young children by the roentgen rays, it is our belief that a detailed account describing the technic will add materially to the value of this report.

First, we would mention apparatus, and here let it be noted that a transformer with ample capacity to 75 K.V. and capable of passing 100 ma. through the tube is the apparatus of choice.

For many subjects the exposures must be practically instantaneous and this, of course, means a heavy electrical discharge in a fraction of a second. A low gap must be employed to register the finer structures of bones which in the normal infant are frail enough and much more so when they are the seat of rickets. It would be desirable to dispense with intensifying screens, because some detail is unquestionably sacrificed when they are employed. Apparatus capable of energizing a tube adequately and tubes of fine focus equal to being so energized would permit of the use of non-screened films. Our work, however, was done with screens and double-coated films, it being considered expedient to get a good record of any case at the expense of a perfect one.

The long bones were studied and the chest included on the films which showed the humeri. An examination of all long bones, especially the femora and tibiæ, cannot be ignored in any subject examined for rickets. Characteristic findings are not equally distributed throughout the osseous system, and while reports from other sources have emphasized the findings in a single bone, such as the distal extremities of the radius and ulna, it is certain that gross abnormalities may exist in the lower extremities with little or no evidence in the upper. Moreover, it is easier to examine the lower extremities, for they can be strapped to the table while an assistant restrains the body. This is impossible with the forearms, which move with respiration, even though the subject may be otherwise still. The average case can be well studied in this fashion on three films of 10x12 size.

The ideal technic would consist of a fine-focus radiator type Coolidge tube, using 60 to 100 milliamperes at a 2-inch gap or less, and non-screened double-coated films. The resulting sharp roentgenogram or any part of it can easily be enlarged on

[1] Read before the Radiological Society of North America, at Atlantic City, May, 1925.

a slow photographic plate or enlarging paper, preferably the former, to several times the original without loss of detail.

For chest examinations it is advisable to use intensifying screens, inasmuch as rapid exposures are essential to arrest motion.

A standard for time, penetration, milliamperage, and distance must be adopted if serial studies are to be made. The finer changes in calcium content of the bones may be lost if any of the above factors are varied in successive examinations. However academic this may appear, the successful fruition of effort will not obtain unless every item governing the making of a roentgenogram is made constant.

A well-made chest roentgenogram will not only determine the presence of atelectasis and cupping of the costal ends of the ribs, but will obviously disclose the presence of other chest pathology such as tuberculosis, inflammatory processes, or persistent thymus, which last is by no means an unusual finding.

The difficulties involved in studying a single long bone are not materially increased when all the long bones and chest are included, and the resulting data may be of infinitely greater import than the condition of the osseous system.

DIAGNOSIS

According to Marfan, "rickets can begin at any time during the whole period of ossification, which extends from intra-uterine life to about eighteen years of age," but this survey was confined to ages ranging from birth to four years,—children who with but few exceptions were neither the inmates of institutions nor hospitals and who were regarded as normal, as determined by ordinary observation of the average child.

We are chiefly concerned with bone lesions, for, as previously mentioned, the roentgenogram may produce definite proof of the existence of rachitic changes in the bones or epiphyses before it can be established by a clinical examination. In florid rickets, however, the "atelectatic strips" in the chest are frequently seen. They are the result of pressure on the lungs from the swollen costochondral junctions.

The roentgen-ray findings vary with the severity of the lesions and the stage of the disease.

In the mild and early form the only changes are noted in the bones of rapid growth, *viz.*, the distal extremities of the femur and ulna, proximal extremity of the humerus and the metaphyses of the fibulæ.

An ulna, beaker-shaped at its distal end, with the roentgenogram made so that the forearm is resting on the film palm up, is often the only evidence of mild rickets. However, this is commonly associated with slight but definite loss of bone density at the metaphysis of the femur and increased width at this point.

In the severer types the characteristic findings become more numerous and are recognized without difficulty. The metaphysis is out of proportion to the epiphysis, the latter is ragged in appearance and the zone of proliferation between the epiphysis and diaphysis is ill-defined.

The periosteum tends to become thickened, while the dense cortical layer of the diaphysis is thinner. The medullary space is increased in width and shows a marked loss in density. Normal trabeculations are disturbed in that the striking network of fine lace-like lines is replaced by fuzzy shadows, having no orderly arrangement, or a mere smear of substance, having a slightly greater density than the adjacent soft parts; cystic areas along the diaphyses, with breaks in the cortical layer which may represent actual fractures or a loss of continuity, which frequently cannot be regarded as a fracture. The metaphyses are flared and cupped, with margins which are best designated as a deckle edge. This appearance is identical with the margins of deckled paper so common to the bookbinder.

The upper extremity of the tibia may be flattened, having a mushroom appearance, but this is not seen unless the subject

has borne weight upon the legs. Curvatures are common, and in the healed or obsolete cases a definite increase in the width and density of the cortical layer is noted along the concavity of the deformed long bones.

Cupping of the metaphyses begins first in the center and proceeds more rapidly in the center of the shaft than in the periphery, which means that decalcification is faster where bone cells are relatively less; hence, we have the cortical layer projecting beyond the central portion, resulting in a lesion which resembles nothing else and is diagnostic of rickets. Obviously, however, such cupping depends upon the original shape of the bone attacked and the severity of the disease. According to Wimberger, "the distal end of the humerus is never cup-shaped, even in severe cases of rickets," which statement is borne out by our study in this series.

Pathological fractures of the long bones are occasionally noted and if healing is under way the amount of callus is enormous, far in excess of that seen in fractures of normal bones. The callus is likewise exceptional in that it is laid down around the fracture without orderly arrangement, and consists of irregular masses of calcium salts deposited about the breach in the bone.

Fractures seen may have little or no relation to injury but may apparently be produced by muscle pull or mechanical strain. In general, when the exceeding frailty of the bone is considered, fractures are conspicuous by their absence.

Frequent findings in the distal extremities of the long bones are fine transverse lines representing increased bone density, placed parallel to each other and extending for one-fourth to one-third the length of the shaft. These are probably normal markings and represent what may be best explained by periodicity in growth.

In well-developed rickets, or florid rickets, the careful roentgen-ray study of any bone is bound to be rewarded by findings which characterize the disease.

While the extremities of long bones furnish most abundant evidence, the general architectural disorder occasioned by decalcification leaves a well-marked trail. Cystic areas varying in size from a pinhead to dimensions which equal the width of the bone, wave-like appearance of the cortices, thickening of the periosteum, increase in the space between the epiphysis and the adjacent extremity of the shaft, pathological fractures, excessive callus formation, bone atrophy, increased width of medullary space, asymmetry and deformities, periosteitis not otherwise explained, deformities and osteopathies of the thorax, irregular ossification of the epiphyses, crescentic epiphyseal lines with widened, flared and deckle-edged metaphyses, and increase of compact bone constitute the roentgen findings of rickets.

The centers of ossification being without well-defined architectural arrangement, so far as the roentgen ray is concerned, are not adapted to study. If rickets is present, it will be unnecessary to rely upon their appearance for a diagnosis, and in this series, while they were noted and recorded, the result did not justify the effort. According to Wimberger, "complete disappearance of ossification centers may take place in some of the very severe cases, but the delay in the appearance of these centers does not appear to be as great as is generally supposed."

HEALING OR HEALED RICKETS

Healing is characterized by the formation of new bone and a certain sign of healing is the deposition of a line of calcium salts in the zone of proliferation, parallel to the metaphysis. This is noted only in the florid types. In less severe cases the ends of the shafts show increased bone density to a point beyond the normal, so that a chalky white transverse band represents in the healed case the end of the pathological process. In relapsing cases this zone or band of increased density is paralleled by another, representing the healing

of the subsequent attack, with an area of normal or fairly normal bone between them, varying in width according to lapse of time between attacks.

The new bone thus formed, aside from its density, has a far more normal appearance than the diaphysis which existed before the onset of the disease. Here the coarse trabeculations, remnants of cyst outlines, and irregular cortical thickening persist for years.

In this series it was easier to determine the presence of healed or healing rickets than it was to establish a diagnosis of active rickets, excepting, of course, the florid types.

In this connection the tibiæ appeared to be especially rich in signs of pre-existing rickets. The flattened head, deformed shaft with increased calcium deposit along the concavity of the curvature and the peculiar hockey-stick deformity of the distal extremity were quite convincing signs.

Having established a roentgen diagnosis of rickets the question of healing is determined by the dense shadow of increased calcium salt deposit, which, as previously stated, occurs in florid rickets as a white line parallel to the metaphysis and is best seen in the distal ends of the femora. In the less severe cases this increased density is noted at the extremities of the metaphyses of long bones.

The extent and degree of calcium salt deposit, together with a return of normal bone density associated with the obliteration of deckle edges, constitute evidence which indicates a healed process. However simple the roentgen diagnosis of rickets may appear, the fact remains that occasional border-line cases render an accurate statement impossible.

Fortunately, such decisions do not involve any hazard to the subject, for recovery does not depend upon anything more than measures which are applicable to a normal child without injury.

The roentgen findings in the bones of young subjects constitute a field for continued study. Successive semi-annual examinations by the most skillful technic of a considerable group of children would furnish evidence of great interest and value.

DIFFERENTIAL

Rickets in the florid stage presents such characteristic and uniformly distributed osseous lesions that it cannot be confused with other bone diseases. In other types it may be necessary to rule out scurvy and lues, as these may be present in the rachitic subject. No case of scurvy was noted in any of the series included herein.

The presence of a subperiosteal hematoma is the one distinguishing diagnostic sign of scurvy, but elevation or at least periosteal proliferation is not uncommon in rickets, which leads us to the conclusion that a clear differential diagnosis cannot readily be made.

Lues, on the other hand, is more easily differentiated. In the first place, this disease is not uniformly distributed. Its manifestations are confined to a single bone or a few bones, and the lesions are characterized by the presence of bone destruction and bone production simultaneously. It is not confined to the extremities of bones and presents no such clear-cut morphological manifestations as does rickets.

The metacarpals may show luetic changes. In fact, any pathologic process in the metacarpals of an infant aside from trauma should call to mind the possibility of lues.

Periosteal thickening, quite commonly associated with lues, is apt to be confusing. If the two diseases chance to be present at the same time, their differentiation cannot be made by a roentgenogram.

STATISTICAL ANALYSIS OF CASES

A total of 926 children were examined by the roentgen method, with reasonable satisfaction to the group responsible for this work.

The diagnosis made from the roentgenograms in all cases was established by this

method alone and without referring to the clinical history or examination. In nearly all, the roentgen diagnosis was made without the roentgenologist having seen the subject. The cases were divided into groups, as follows: (1) No rickets; (2) mild rickets; (3) healing rickets; (4) healed rickets; (5) florid rickets; (6) florid healing rickets; (7) florid healed rickets.

Of the 926 cases, 636 (66.5 per cent) had rickets in some of the above types. The total cases examined among the white children numbered 596, of which 353 (59.2 per cent) were rachitic. Total for colored was 330, of which 269 (79.7 per cent) were rachitic. Florid rickets in the whites numbered 83 (9.2 per cent) and 71 (21.5 per cent) in the colored.

By clinical methods of examination 1,439 were studied, of which 1,101 (68.7 per cent) had rickets, with 61.4 per cent for the white and 81.5 per cent for the colored.

There is a slight discrepancy between the clinical and the roentgen methods inasmuch as 68.7 per cent had rickets according to the former, while 66.5 per cent were rachitic as determined by the roentgen ray, but the figures are striking in that they are practically identical and were secured by approaching the subject from two widely separated angles. It may be stated here that cases were claimed as normal unless the roentgenogram gave substantial evidence in favor of the disease, and for the purpose of establishing a diagnosis of rickets it is believed that the roentgen ray offers more dependable data than can be secured by a clinical study. It is especially true of the early florid type.

This study was made under the direction of the Children's Bureau, Department of Labor, at Washington, and our grateful appreciation for invaluable assistance rendered by the officials of this Bureau is acknowledged. Also, we are indebted to the Children's Hospital, Washington, for the assistance rendered by Miss Mattie Johnson, of the X-ray department of that institution.

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RELATIVE INDICATIONS FOR SURGICAL AND RADIATION THERAPY IN CERTAIN BORDERLINE CASES[1]

By IRVIN ABELL, M.D., Louisville, Kentucky

IN presenting a paper before this Society, in which irradiation therapeutics are considered, the writer wishes to make it clear at the outset that he is unable to discuss the subject from a technical standpoint: while using X-ray equipment since its introduction, such usage has been for diagnostic purposes only. All cases requiring therapeutic treatment, both roentgen and radium, have been referred to the radiologist, and the following observations are based on this joint experience.

It is the writer's belief that efficient, scientific radiation therapy requires an unusual degree of differentiated, highly specialized knowledge and, consequently, that its employment should be in the hands of a man possessing this qualification. His knowledge of disease and of morbid anatomy must be broad, otherwise the radiologist becomes a mere technician with no medical vision, even as the graduate in medicine may become an operator and yet fail to acquire the broadness, discernment and judgment vitally essential to his becoming a surgeon. The surgeon who does not give his patients the benefits of irradiation is as culpable as the radiologist who does not give his patients the advantage of surgery. It is not only useless but subversive of the best interests of both patients and the profession to pit one against the other, particularly in ailments which are destructive of life, since, if I may so express it, they are synergistic, one complementing the other. To realize the indications for the use of each, with its individual limitations, and to select the one or to judiciously combine the use of both, as the case demands, is to exhibit that correctness of mental attitude and spirit which implies professional progress and service.

Many of the problems which confronted us in the past have been settled to the satisfaction of both surgeon and radiologist, while others present phases that are well worth joint discussion. The writer has done no operation for cancer of the cervix since the early part of 1920, all such patients being treated by irradiation. One patient with an ulcerating cauliflower epithelioma of the cervix died of septicemia following such treatment, the trauma incidental to placing the capsule in the mass apparently being the starting point of a rapidly spreading infection. The results in the remainder have been more beneficent than those formerly obtained by surgery: lessened risk, lessened morbidity and discomfort, with a more effectual removal of epithelial growth. The adage respecting cancer, that cure depends more on duration of time than upon extent of treatment, while applicable to cancer in all situations, is particularly so to cancer of the cervix, on account of its rapidity of extension; regardless of the time at which such patients come under observation, irradiation is the treatment of choice.

In carcinoma of the uterine body, surgical removal has given uniformly good results. Cancer in this situation does not metastasize as rapidly as in the cervix; there is no indication for extensive broad ligament dissection; the mortality of hysterectomy is approximately 2 per cent and the number of ultimate cures is relatively high. Of five patients seen in the last five years with adenocarcinoma of the body of the uterus, in whom obesity, hypertension or cardio-renal disease rendered surgical removal inadvisable, three are known to be dead from extension and one now to present evidence of same. All were treated with radium in an initial dosage of 2,000 to 3,000 mgm. hours, followed in two to four months by a second dose of similar strength. The patients, when first seen,

[1] Read before the Radiological Society of North America, May, 1925, at Atlantic City.

were operable, as considered from the viewpoint of uterine pathology alone, the organ being movable and the broad ligaments apparently free from invasion. In the light of such experience, namely, the uniformly satisfactory results of hysterectomy and the unsatisfactory results of irradiation,—in a limited number of cases it is true, but unsatisfactory nevertheless,—the writer believes surgical removal to be the procedure of choice in carcinoma of the uterine body.

In uterine bleeding due to benign lesions, irradiation has found one of its most brilliant fields of usefulness. In bleeding uteri which present no demonstrable abnormality other than a simple or hypertrophic glandular endometritis without associated adnexal disease, a condition which has constituted the real problem of the bleeding uterus and is now assumed to be due to a hyperfunctioning of the ovary or endocrine disturbance, irradiation has given incomparably better results than surgery. Repeated curettage gives but temporary relief, indicating the cause to be elsewhere than in the endometrium. Formerly, hysterectomy was not infrequently resorted to for the control of such bleeding,—an operation, in magnitude and danger, out of all proportion to the demonstrable pathology.

Previous to the advent of radium, such of my cases were treated with roentgen therapy, complete satisfaction being experienced in patients over forty, in whom induction of the menopause did not constitute an objection to this method of treatment. In younger patients, the difficulty of determining the dosage that would stop bleeding and yet fall short of producing the menopause, presented a serious argument against its routine employment. In cases in which it was employed, recurrence of bleeding was occasionally noted: in one, aged thirty-two, menstruation was absent for two years, during which time the nervous phenomena of the menopause were present in marked degree. At the end of this period the bleeding recurred and to such an extent that at the end of four months the uterus was removed. Since using radium the greater accuracy of the dosage has given more uniformly good results, for we are able to control the bleeding without (unless by intention) producing the menopause. And yet such control is not to be obtained invariably, as shown by the following experience. Patient unmarried, age 31; menorrhagia and metrorrhagia of such extent as to reduce hemoglobin to 28 and red cells to 1,800,000. Diagnostic curettage showed hypertrophic glandular endometritis, uterus and adnexa otherwise negative. Transfusion and 300 mgm. hour dosage of radium produced a return to normal menstruation for six months, when the metrorrhagia recurred, and in four months the secondary anemia was again marked. A second dose of radium, this time of 600 mgm. hours, was administered and again normal menstruation was re-established for six months, when metrorrhagia again recurred. Fearing the induction of the menopause if a larger dose of radium was used, the uterus was surgically removed. Microscopical examination showed nothing further than endometritis.

The indications for the treatment of fibromyomatous growths involving the body of the uterus are variously interpreted by surgeon and radiologist. The logical analysis of the situation appears to me to be as follows: In women under forty, presenting such growths, the treatment of choice is surgical removal, employing transfusion and irradiation in moderate dosage for the purpose of making operable those patients in whom continued bleeding and profound secondary anemia temporarily prohibit operation. The reasons for this conclusion are: First, ocular inspection will in some cases permit of myomectomy, with the preservation of the child-bearing function; second, preservation of the ovaries, independent of the retention or ablation of the uterine body, is of great importance. The younger the patient the greater the importance of the preservation of the ovaries, because of their internal

secretion and the part they play in the establishment and maintenance of the sex function, particularly in the earlier years of life. Again, many women have an abhorrence of the induced menopause, regardless of how produced, whether by surgical removal of ovaries or by their destruction by radiation. Irradiation of fibromyomata in such women may engender an inferiority or abnormality complex, rendering them unhappy for the remainder of their days, and, surely, mental tranquillity transcends in importance the 2 per cent risk which operation entails. It is readily admitted that there is an opposite picture to this, namely, those who desire and prefer irradiation, even though it involves destruction of the ovaries, rather than operation, with its concomitant pain, discomfort, confinement and convalescence.

At and after the age of forty the childbearing function of the uterus has usually been fulfilled; the distortion of the organ incident to growth may be such as to prevent conception or to interfere with pregnancy, granting its occurrence, and the proximity of the approaching menopause makes negligible the importance of ovarian preservation. Hence irradiation at this age finds a comparatively wide field of usefulness, its limitations being determined by the size of the tumors, by pedunculation, by tumor degeneration and by adnexal disease.

Another lesion in which my experience has demonstrated an increasing range of applicability of irradiation is tuberculous cervical adenitis. Beginning with the roentgen treatment of sinuses following operation, its use has been extended, until, at present, only those presenting enlargement of single or small groups of glands, those with large confluent masses of caseating glands and abscesses of appreciable size, are subjected to operation, the former for the establishment of correct diagnosis, the latter two for the purpose of immediately getting rid of massive foci of infected tissue, followed, in each instance, with radiation. Since adopting this method of treatment there has been a welcome absence of recurrences.

The real bone of contention between the internist, the surgeon and the radiologist is the thyroid. We are fairly well agreed that the adolescent thyroid needs no treatment, merely proper hygiene and proper living until the attainment of maturity: that the colloid goiter requires only medical care unless its size or cystic degeneration demands surgical removal; further, that adenomata, both simple and toxic, are best treated by surgery. The real crux of the situation is encountered as we approach hyperthyroidism. The symptom complex so designated is in whole or in part due to excess of thyroid secretion, with varying degrees of follicular hyperplasia, dependent on a cause with which we are, so far, unacquainted. The excess of secretion drives the nervous system and the nervous system, in turn, drives the secretory activity of the thyroid,—a truly vicious circle. Again, in some instances it appears as a uniglandular, in others a pluriglandular, affection. Its course is characterized by periods of exacerbation and periods of remission, with, sooner or later, myocardial and renal degeneration. The prime consideration is the reduction of thyroid activity and at a time before secondary degenerations have occurred. In my experience, some of the milder types of cases have made apparently complete recoveries under radiation; most have been improved, some of whom later again showed signs of activity. In one series of twelve cases treated by X-ray alone, five were classed as cured, six improved, and one unimproved. In a series of thirty-eight cases presenting definite thyroid enlargement, thrill and bruit, rapid pulse, high metabolic rate, weight loss and weakness, roentgen treatment was employed preliminary to operation. In the vast majority of this series the thyroid cellular activity was diminished and the operation made safer. In some, there was no appreciable benefit from the radiation. It is a significant fact that routine microscopical examination of

the removed tissue showed in each instance follicular hyperplasia, indicating that the action of the ray had been an inhibition of cellular activity rather than a destruction of hyperplastic cells. In two of this series in which routine X-ray and bilobar resection of gland were employed, symptoms of hypothyroidism developed during the third month following operation. A short period of thyroid feeding was followed by their disappearance, since when, now one and three years after operation, there has been no recurrence. My interpretation is that the X-ray inhibited the thyroid activity so that, with a resection of four-fifths of the gland, insufficient secretion was formed, and that such inhibition was temporary, since shortly thereafter and up to the present time there has been no further evidence of hypothyroidism. This assumption is borne out by the observation of marked improvement, followed later by activation, in other cases treated by X-ray and not subjected to operation.

Recurrence of thyroid overgrowth, with associated symptoms of hyperthyroidism, following bilobar resections for hyperplastic toxic goiter, has in my experience occurred in approximately 3½ per cent of cases. Of those coming back under my care, five were irradiated, with complete clearance of symptoms in three; in the remaining two, in which there was no appreciable result from radiation, operation revealed hyperplasia, with multiple small adenomata in the enlarged side.

Bearing in mind that in attacking the thyroid we are not eliminating the cause of the disease, but are mitigating or removing one of its most distressing features, the explanation of the failure to cure all cases by any method is readily at hand. The intelligent co-operation of the internist, the surgeon and the radiologist in the management and treatment of hyperplastic toxic goiters will, in the light of our present knowledge, give the greatest percentage of improvements and symptom-free cures.

Cancer of the breast affords another joint problem to be solved by the intelligent co-operation of the surgeon and the radiologist. I am aware of the impression which exists among radiologists that such lesions should be given both pre-operative and post-operative irradiation. But is the improvement in percentage of cures sufficient to justify the expenditure of time and effort in re-educating both the profession and the laity regarding it? Such treatment necessitates four to six weeks' delay in removing the breast and cancer-bearing tissues. Even granting the inhibition of cancer cell activity and the sclerosis of the lymph paths thereby obtained, what is the advantage in early cases over wide removal of involved and possibly uninvolved structures? Experience has so firmly convinced me of the truth of the adage quoted earlier, that cure depends on duration of time rather than on extent of treatment, that I am unable to see the benefit in such delay, with the possible exception of late cases. In 1921 an analysis of a personal series of 110 operations for breast cancer was made, being successful in tracing 88 of the patients, of whom 49 were well and living from three to sixteen years following operation, a percentage of 44.5 per cent of the total number and of 55.7 per cent of the number traced. Grouping these according to duration of lesion it was found that in the group coming so early that a diagnosis of carcinoma could be reached only by frozen section, comprising 25 cases, I had 76 per cent living and well three years or longer after operation, and none of these had had X-ray treatment. The percentage of three-year cures rapidly decreased with the increased duration of the disease, and somewhere in these groups it is possible that pre-operative radiation will secure an increased number of cures. Unless the increased percentage is a very definite one it will be a difficult matter to convince patients coming from a distance of the wisdom of a course in radiation, a return to their home for a number of weeks, a second visit to the hospital for operation, and finally a third one for an-

other radiation. The monetary consideration for many is prohibitive, while with others it will work a distinct hardship. Does the working out of such a technic give results that will justify its execution, especially in the light of the experience quoted above? Is not our improvement in results to come, rather, from education of both the profession and the laity regarding the significance of breast tumors, to the end that early microscopic recognition may permit of operation, followed by irradiation, so that we not only secure a higher percentage of cures but the patient is spared the necessity of more than one trip to the hospital? Beginning with 1920, I have employed post-operative radiation in all but the earliest cases, and, while no follow-up has yet been made, it is believed that this series will show an increased percentage of cures as compared with the corresponding groups of the series above quoted.

X-rays and aplastic anemia.—The author is convinced that X-ray and radium treatment of leukemia is of definite benefit to the patient. While, in the long run, all cases die of the disease or of an intercurrent affection, yet she feels sure that the average length of life is greater than it was before radiation became general, or that it is with any other form of treatment. Gulland emphasizes the need of frequent blood examinations during treatment, because of the possibility of the development of an aplastic anemia if the irradiation is carried on for too long a period. He stops treatment by radiation when the leukocyte count drops to 20,000, since the effect goes on for some time after radiation has been stopped.

Whitcher has reported one case in which radium treatment did produce an aplastic anemia. The author also reports her own case of splenomedullary leukemia which developed an aplastic anemia following X-ray treatment.

Spontaneous termination in anemia of an aplastic type has not been described as taking place in cases of splenomedullary leukemia. Both the author's and Whitcher's cases seem to show that radiation either with X-ray or radium may convert a case into aplastic anemia.

It is obvious that more work needs to be done before the optimum dosage of radiation is fully known, before it is determined at what point the treatment should be suspended. The total number of white cells alone does not seem to be sufficient indication of the progress of treatment. The proportion of abnormal cells and any fall in the red count should be carefully taken into consideration.

SOLOMON FINEMAN, M.D.

Aplastic Anemia Following Treatment with X-rays. Joan M. Ross. Lancet, April 25, 1925, p. 867.

Diagnosis of early tuberculosis.—Incipient tuberculosis is difficult to diagnose and all the factors of history, physical examination and laboratory findings must be carefully considered before making either a positive or negative diagnosis. The X-ray is useful in these cases. Under the fluoroscope lagging of one side of the diaphragm may be detected, or cloudiness in the apices. Stereoscopic films may show enlarged hilus glands or involvement of the apices.

W. W. WATKINS, M.D.

The Differential Diagnosis of Early Tuberculosis. George R. Harris. Atlantic Med. Jour., April, 1925, p. 449.

FURTHER STUDIES IN THE EFFECTIVENESS OF DIFFERENT WAVE LENGTHS OF RADIATION [1]

By FRANCIS CARTER WOOD, M.D., NEW YORK

IN a recent number of the *American Journal of Roentgenology and Radium Therapy* (1924, XII, 474) I published a paper giving some preliminary studies of the effects of two different wave lengths of X-ray on standard animal tumors and showed that with equal ionization dosage, when the chamber was of the Duane type, the tumors were killed at approximately the same time. These experiments have now been extended to another type of tumor with the same result, and a résumé of some of the more recent findings may be of interest. I refer to that paper for the details of the production of the X-ray and the filtration.

One of the peculiar advantages of using animal tumors in this type of study is obvious, as it is possible to determine the death-point within the accuracy of any biological experiment. If tumors are inoculated after exposure to X-rays, and grow, they are evidently not dead; if they do not grow, they evidently are dead. This avoids the use of any reagent or morphological change in the cells for the determination of their viability.

For example, the decolorization or non-decolorization of methylene blue has been used by von Wassermann as a test for cell-death after radiation, but even if such color change is reliable, and its value has been denied of late, a few cells might be still alive and yet not furnish sufficient mass of tissue to decolorize the whole bulk of fluid. Just the same, a recurrence would be due to these few remaining cells.

Again, the employment of vital stains for microscopic determination of the viability of cells is attended with gross errors. The minute histological structures of cells are not altered by X-ray in a characteristic manner, so that no conclusions can be drawn from this aspect.[2]

The determination of the effect of radiation of bean seedlings as practised by Jüngling[3] again depends upon many condi-

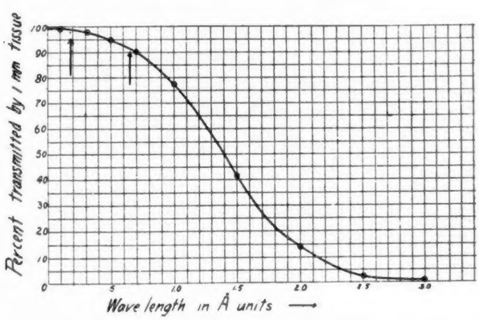

Chart I.—Chart showing the percentage of X-ray transmitted by 1 mm. of tissue at various wave lengths. The arrows indicate the two wave lengths used, 0.2 and 0.6 Å. At the shorter wave length the absorption is negligible; at the longer it amounts to only about 8 per cent of the total. The air in the 10 cm. ionization chamber absorbs about one-eighth as much as the tissues.

tions other than the death of all the cells, for the rays may wholly prevent or seriously check growth whether a large number or a small number of cells be destroyed. The same complications affect the use of the death-point of mice, proposed as a test by Meyer and Ritter,[4] and the results are quite variable and unreliable.

Further obvious convenience of animal tumors is that such thin slices can be employed in the radiation tests that but little absorption of the rays takes place in the tissue used. A millimeter of the soft substance of the tumor has almost no absorptive power at the voltages ordinarily used, certainly no more than a meter of air.

[1] Read at the tenth annual meeting of the Radiological Society of North America, December 8-12, 1924, at Kansas City, Missouri.

[2] Prigosen, R.: Jour. Cancer Res., 1924, VIII, 325.

[3] Jüngling: München. med. Wchnschr., 1920, LXVII, 1141.

[4] Meyer and Ritter: Strahlentherapie, 1912, I, 183.

Chart I shows the curve of absorption with different wave lengths for a millimeter of tissue. Obviously absorption and scatter are both included.

The curve for air absorption of X-rays at the same wave lengths practically covers that for tissue at short wave lengths, if the difference in density between air and tissue is taken into consideration. In other words, within the limits of 0.2 and 0.6 Ångströms, which is that used in my experimental work, as indicated by the arrows on the chart, the mass absorption coefficients of air and tissue are practically the same. The short open ionization chamber therefore depends upon very little absorption for its measurements, because that absorption, as well as that of the tissue, is only a small fraction of the total energy of the beam which passes with great facility through both.

The slight difference which exists is, of course, in favor of the shorter wave lengths. Thus, 2 or 3 or even 5 per cent between the top and bottom of the different tumor fragments might with longer wave lengths permit an especially resistant cell to escape, and it will be noted later that the death-point of tumor cells with higher voltage is sharper than with low. With the lower voltage we are apt to get one or two growing tumors out of fifty exposed particles when the lethal point is nearly reached, so the difference in absorption may account for these slight biological variations.

As soon as thicker layers of tissue are employed, the absorption increases rapidly, so that the curve falls almost directly to the base line, and the only way in which estimations could be made would be by an ionization chamber which absorbed all of the X-ray. In that case, however, only the thin slice at the upper surface of the tumor could be used, because the absorption would vary with the depth, and incalculable scatter and portal effects on even the surface layer make their appearance. This is the condition which obtained in a previous paper, where experiments were reported on the killing point of tumor cells in different depths of water. Here it was possible to place cells in a medium practically equivalent to tissue and remove them whenever the exposure was completed. The tumor cells under these conditions really act as might very minute ionization chambers.

The advantages of the open ionization chamber are also obvious. All the electrons are produced in an open space of definite dimensions in a standard gas, and without any complications introduced by scattering from the metal or other solid material used to inclose the gaseous medium.

The length of the column seems to make but little difference in the measurements. Experiments with a chamber inclosing a 10 cm. column of air and one inclosing 50 cm. showed that the longer tube gave only a few per cent higher values than the short. This has also been noted by Duane.

Instead of lengthening the column so as to make the absorption of the air exactly the same as the absorption of the tumor it is possible to close the ionization chamber and use air under pressure. Thus a 10 cm. chamber containing air at 10 atmospheres pressure will be the same as a 100 cm. chamber under normal pressure. There are certain disadvantages in the longer chambers, owing to the high voltage required to produce a saturation current. These are due in part to the necessary divergence of the electrodes at the portion distant from the source, in order to prevent the X-rays from striking the electrodal surfaces.

It can be assumed with considerable probability that the relative energy of the X-ray beam is determined within the limits of biological accuracy by the use of such an ionization chamber. That such chambers measure the biological effect is both affirmed and denied, the latter attitude being held by Holthusen,[5] who says that the biological effects do not run parallel with the ionization measurements, though he

[5]Holthusen: Strahlentherapie, 1924, XVII, 49.

believes that the energy does.[6] The final proof of the energy question must be made by calorimetric or other determinations of the total energy of the beam of X-ray, but so far this has been too difficult a problem for the physicists to solve experimentally in any satisfactory manner.

Another complication which has recently been added to the already difficult problem of the nature of the biological action of X-ray has been the suggestion from several sources that the so-called Compton effect might be of importance. The Compton effect is a slight change in the wave length which results when X-rays are scattered. The increase in the wave length is independent of the hardness of the original beam and is greater with material of low atomic weight. Such softer scattered X-rays produce low velocity electrons, these in turn low velocity X-rays, and so on, down the scale. But fortunately for our peace of mind it has been shown that the energy of such altered wave lengths is only a small percentage of the whole energy of the original beam, and it is very unlikely, therefore, that it plays an important part.

Recently Lorenz and Rajewsky[7] have suggested that the recoil electrons at high voltages are a more important factor biologically than the photo-electrons directly produced. But as the quantity of recoil electrons increases, that of the photo-electrons diminishes, and the sum total is the same, whichever produces the greatest biological effect. There is some evidence against there being any sharp change at higher voltages from one type of electron to another, for when the output of a tube is measured by an open ionization chamber the quantity of X-ray so measured increases linearly. There are no kinks or abrupt changes in the course of the measurements between 150 kv. and 220 kv., the ordinary limits of radiotherapy. It is a question, therefore, whether the injection of this new complication into our problem is important. If the ionization measurements are the same, the ionization effects in tissue must also be proportional, as no biological distinction can possibly exist between the effects of the two electron types.

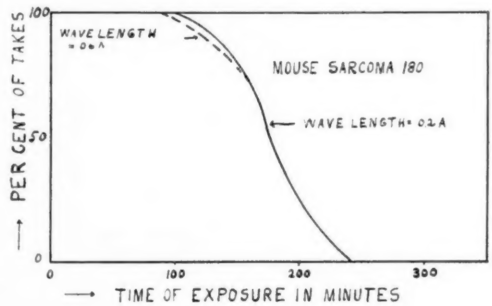

Chart II.—Chart showing percentage of takes and time of exposure in minutes to particles of Mouse Sarcoma 180. The dotted curve shows the percentage with longer wave lengths; the solid line with the shorter wave length. The two lines practically correspond through a large part of their length.

Turning now to a more practical phase of our work, Charts 2, 3, and 4 show the effect of a continuous voltage on a molybdenum tube filtered so as to pass X-rays whose wave length is about 0.6 of an Ångström and superimposed on this the curve of death-points for a tube with tungsten anticathode and tantalum filter, giving an average wave of 0.2 Å. The first two with tumor No. 180 and the Flexner-Jobling rat carcinoma have already been published in slightly different form; that of Rat 10 is new. Rat 10 is an actively growing spindle-cell sarcoma of high inoculability and, consequently, considerable resistance to the X-ray. The Flexner-Jobling rat carcinoma is destroyed at 195 and 180 minutes' exposure, respectively. Crocker Fund No. 180 mouse sarcoma requires 240 and 255 minutes, while Rat 10 requires 330 and 300 minutes for its complete destruction. These variations in susceptibility to radiation are in line with those I have already demonstrated before this Society as occurring in animal tumors, just as they occur, you will all grant, in human tumors.

[6] Holthusen: Fortschritte auf dem Gebiete der Roentgenstrahlen, 1918-19, XXVI, 212.
[7] Lorenz and Rajewsky: Strahlentherapie, 1924, XVIII, 473.

The maximum difference in the effects of the different wave lengths amounts only to some 10 per cent, and if a larger number of tumors were exposed and the intervals lessened this difference would probably be obliterated. Such intervals need scarcely be closer than fifteen minutes because the errors in measuring the voltage, the current through the tube and the ionization current can scarcely be less than 5 per cent under the best conditions, even while the apparatus remains at the same set-up. If a tube is shifted, resetting is necessary, and it is very doubtful if ionization readings of an accuracy greater than 5 per cent can be made.

As I have suggested earlier in this paper, it may be that the absorption of the X-rays in the tumor particles themselves is sufficient to spare a few most distant cells of the many thousands in each particle.

In one of these experiments, out of 48 tumors exposed at 300 minutes, of, for example, Rat 10 under molybdenum, only two came through and produced growth. It may happen in the higher voltages that within the next few weeks one or two tumors may still appear at the 300 point, thus deferring the lethal limit to 330 minutes. As a matter of fact, these experiments are being repeated using large numbers of the same tumor at the 300 and 330 points so as to see how accurate this determination is. In any case, a 10 per cent variation is perfectly possible in such biological experiments, owing to the impossibility of getting exactly equal samples of tumor tissue. Some parts of the tumor from which the grafts are taken may be older and more resistant than other portions which are rapidly growing and contain easily damaged cells.

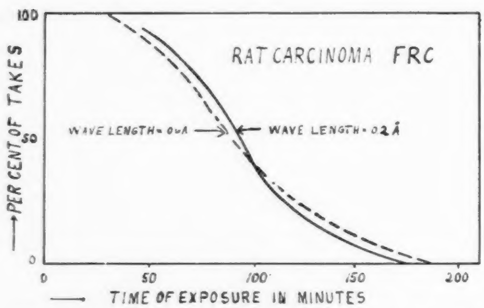

Chart III.—Chart showing the percentage of takes and time of exposure in minutes of Rat Carcinoma F.R.C. The dotted line shows the percentage death-point for the longer wave length; the solid for the short. The close coincidence of the two is obvious.

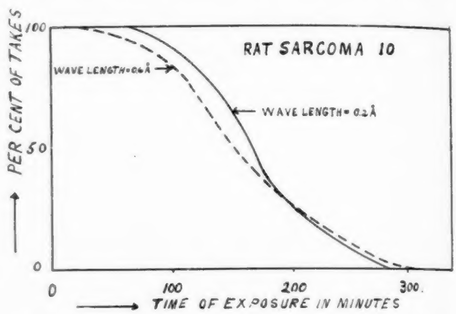

Chart IV.—Chart showing percentage of takes and time of exposure in minutes of Rat Sarcoma 10. The dotted line shows the death-points for long wave lengths; the solid for short.

We have, therefore, experiments on three different types of tumor in which the death-point differs with each, but the death-point with different wave lengths for all practical purposes corresponds.

Exactly similar curves are given with radium, as you see from the next figure, Chart V, which is mouse tumor No. 180, exposed to that substance for varying times.

The curve is a little steeper at the first portion because the short periods were omitted in our tests, but the general trend of the curve is the same. Experiments are now under way to obtain similar curves with other tumors and also at about 220 kv. with X-ray, but the work is slow, as many of the heavily radiated tumors do not appear in the animals for some three months. It takes nearly a year's work, therefore, to get the figures shown in these six lantern slides, not to mention the slaughter of eight to ten thousand animals.

Holthusen has shown similar curves for human erythema skin doses using X-ray, and I showed some years ago that the ery-

thema dose of the human skin was a definite fraction of the lethal point of the same type of radiation for tumor cells. Thus, human skin and three animal tumors and

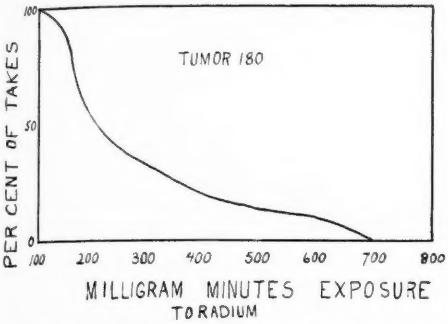

Chart V.—Chart showing effect of radium filtered by 1.2 mm. of brass and 5 mm. of filter paper. The percentage of takes is represented on the vertical lines, the milligram hours on the horizontal. It will be seen that it takes about 700 milligram hours to destroy all of the cells of Tumor 180. This is approximately five human skin erythema doses.

also the eggs of the fly *Drosophila* give closely parallel results over a variety of wave lengths and an inevitable conclusion is that, within the error of all our biological work, a given quantity of X-ray when measured by an open ionization chamber has an equivalent biological effect.

The nature of these curves is quite general. They correspond very closely with the mortality curves of human beings as published in the life insurance mortality tables. They are quite similar to the curves produced by the killing of bacteria with disinfectants and the hemolysis of red corpuscles by serum or saponin. They represent, therefore, the effect of a continuous destructive agent upon a population of varying resistance. Human beings vary in their resistance to the agencies which cause death. If they did not, every one would die at the same age. If red corpuscles were all exactly the same in their resistance to hemolytic agents, total hemolysis would occur at a definite point and no hemolysis previous to that point at which the concentration of the hemolytic agent becomes effective. No two tumor cells have exactly the same resistance to X-ray; therefore some are killed easily and some with difficulty,—just like human beings. As an illustration of this point, Chart VI is a plot on what is known as logarithmic-probabil-

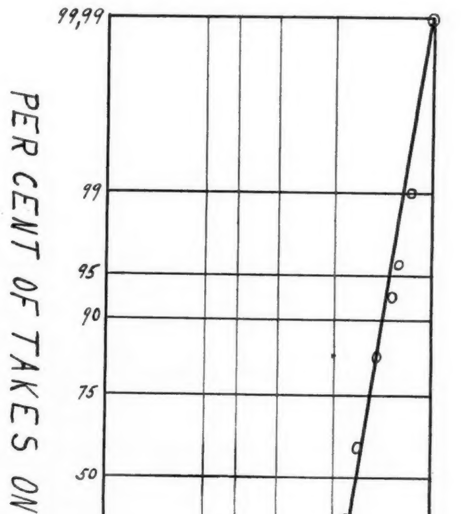

Chart VI.—Percentage of takes from Chart II, plotted on logarithmic-probability paper.

ity paper, the use of which was suggested to me by Prof. W. T. Bovie of Harvard University. The circles are the death-points of tumor No. 180. The straight line with which they closely coincide is the graph

of the probability curve, which is straight because of the peculiar ruling of the paper. The percentage destruction of bacteria and the percentage hemolysis of red corpuscles plot in a perfectly similar fashion on this paper. Evidently all of these phenomena are therefore of similar type, as just said, a destructive agent acting on a variable population.

I need not point out to this audience the practical importance of the main facts of this paper: that is, that there is little or no difference between the action of short and long wave lengths of X-ray, within the limits of ordinary practice, when the quantities are measured by an open ionization chamber. It greatly simplifies our radiation therapy and places it on a very much better foundation. If different wave lengths do not differ in their effectiveness then we can select whichever wave length is most suitable in regard to the depth of tissue that must be penetrated to reach the tumor, and feel assured that the growth has been treated as effectively as possible.

It stops at once the discussion as to whether radium or X-ray is most effective when used in the same fashion, and also the widely current view that there is something magic in X-rays produced at 200,000 volts or 250,000 volts, which is not inherent in those produced at lower voltages. It renders improbable the discovery of a special selective ratio between tumors and normal tissue at some specific wave length, because if the elements of human skin and mouse tumor have correlated death-points, the same is probably true of both the deeper tissues and human tumors. We still have left two important variables, organ susceptibility and tumor resistance. Radium will always retain the unique advantage over X-ray that tubes carrying it can be inserted into the substance of a tumor and therefore the rays need not be transmitted through the skin.

DISCUSSION

Dr. J. E. Gendreau (Montreal): Dr. Wood has proved that to kill a certain cancer cell with soft X-rays, it takes five times the dose required with those rays to produce a skin erythema, and also he has proved that to kill the same cancer cell with hard X-rays, it takes also five times the dose required by those hard rays to produce a skin erythema.

I would like to know if the skin erythema is the same in both cases with different kinds of rays; if to cause the same erythema it takes the same amount of absorbed energy with different rays, and also if the ionometric measurements are comparable with all kinds of X-rays.

Dr. H. J. Ullmann (Santa Barbara): I would like to ask Dr. Wood a question: Can you compare an erythema dose of unfiltered with an erythema dose of copper-filtered radiation? I gave, in one instance, through copper a dose which resulted in swelling of the skin and deep red color. Complete restitution occurred and a final regrowth of hair some months later. I have yet to see and yet to find anyone who has seen permanent epilation from copper-filtered radiation, even when the skin showed sharp reaction, far more than would be permissible with unfiltered radiation and where permanent epilation occurs.

Dr. Wood (closing): All these questions which have been asked have been very much to the point, and I am sorry that the limitations of time would not let me discuss them in my paper.

These charts represent a biological phenomenon which covers animal and presumably human tumors, a phenomenon valid for the animal kingdom at least, and probably also including plants, as Jüngling has shown. It is of practical interest that life insurance companies can build a profitable business on a curve similar to that which we obtain in raying animal tumors. Now it is true, as Dr. Bovie says, that if

these phenomena which I described prove to be general, that we will select a given X-ray for a given purpose, and that it is really the quantity of energy absorbed by the cell which does the damage and solely that. What happens in the cell is an enormously complicated process of which we know very little, but what affects the cell must be what stays in it and certainly not that which goes through it, and I think that the biological results are directly in proportion to the amount of energy absorbed.

Now Dr. Gendreau asked another question.

The physicists are far from telling us anything about the total energy of an X-ray beam, and when our bolometer friends get their bolometers working, we will be much closer to the answer because such an instrument does measure the energy of an X-ray beam, and it will then be possible to say just how much energy goes through tumor cells and how much stays in, but I did not say anything about X-ray energy because I know nothing about it. That question is still to be settled, but we used an open ionization chamber, which the physicists think is about the best instrument there is at present. I believe the ionization chamber closely measures the energy, and I also believe that those experiments in all probability show that equal energy absorbed in tumor cells is equally effective. When we come to a complicated structure like the skin the situation becomes more complex. It is true that an erythema produced by unfiltered radiation is a different thing clinically from an erythema which we occasionally produce at a high voltage, and it has seemed to me that we have to go back to the physiology and anatomy of the skin for the explanation. When unfiltered radiation is used the main penetration is only a small fraction of an inch, to which the erythema dose is confined. There a high absorption and a wholly superficial and very active erythema is obtained, which, however, does not affect the deeper structures of the tissues but spends itself on the surface; but when an erythema is produced with heavy filtration at 200,000 volts, it may be two or three inches deep, and the superficial skin is getting scarcely more than the deeper layers, and such an erythema is entirely different. The resulting deep necroses show how deep the erythema is, because the damage is not confined to the surface but has also gone deep. The explanation of the clinical differences lies in the different portions of the tissues which are affected.

Tissue biopsy.—This paper is a plea against unnecessary delay between diagnostic incision of tumors and complete operation, when malignancy is found to be present. In the more malignant forms of cancer, a two-stage procedure has been proven almost to destroy all chances of cure. In other locations (uterus and cervix) the evidence is not so convincing as to absolutely condemn curettage or removal of a piece of tissue and delay for laboratory diagnosis, but the ideal procedure is frozen section diagnosis and immediate complete operation when positive evidence of the presence of cancer is found.

In the case of the lip complete removal of the primary growth, rather than incision of the growth, is a safe procedure. Dissection of the neck lymphatics may be carried out at a later time, depending on the microscopic appearance of the primary growth.

SOLOMON FINEMAN, M.D.

Doubtful Tumors—Shall We Excise a Piece for Diagnosis? A. R. Kilgore. Calif. and West. Med., April, 1925, p. 434.

STUDIES ON THE SUSPENSION STABILITY OF THE HUMAN BLOOD [1]

I. THE VELOCITY OF THE SEDIMENTATION OF ERYTHROCYTES IN X-RAY THERAPY CASES

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From the X-ray Department of Mount Sinai Hospital, Cleveland, Ohio.

SINCE the introduction of the roentgen ray in medicine as a therapeutic agent, one of the factors that has always challenged the interest of biologists is the human blood and its changes during the application of radiation. We do know now that the leukocytes (1) are most sensitive to X-rays, and we, further, know something about the physico-chemical changes (2) taking place in the blood of radiated patients.[2] Chiefly the study of the alterations of the equilibrium of the serum and plasma promises to give us a more thorough understanding of the X-ray effect on human beings. I mention Herzfeld and Schinz (3), who have noticed a decrease of the viscosity of the blood and a shifting of the colloidal phase: the ratio of the albumines and globulines was inversed, in favor of the globulines, or, in other words, the dispersity had become different. The authors used the refractometer (Pulfrich) in their experiments, but there is another method which enables us to get a definite idea of the changes taking place in the colloidal composition of the blood: the observation of the velocity of sedimentation of the red blood corpuscles.

The phenomenon of the sedimentation of the erythrocytes is well known; in fact, Hunter (4) undertook a systematic investigation of that subject over a century ago, although this was forgotten until 1916, when a Swedish author, Fahraeus (5), rediscovered it. He carried out a number of experiments on the theory of the suspension stability of the blood under the well-known physiologist, R. Hoeber, at the University of Kiel, Germany (6), and it is a gynecologist of the same University, G. Linzenmeier (7), to whose intensive work we owe the introduction of this method into the clinic, and who has given, also, a good technic for its performance. It is impossible to judge already the value of this test, but it has been useful in the diagnosis of infections, tuberculosis, and pregnancy. As to the theory of it, I will mention here only that it is positive that the reaction is unspecific; it is very probable that changes of the electrical charge (8) of the blood corpuscles are the cause of the whole phenomenon. The fibrin plays also a certain rôle in it. This, however, is still a hypothesis, and not definitely decided.

I could not find much in the literature about studies of the sedimentation test in the course of X-ray treatments; Risse (9) reported a small increase in some cases, a definite decrease of the sedimentation velocity in most cases. Klein (10) could find a distinct influence of the radiation in only 50 per cent of his patients. A more detailed paper has been published by v. Mikulicz-Radecki (11), who classes his patients in three categories: post-operative radiation, sterilization for benign conditions of the uterus, and inoperable cancers. The patients given a post-operative X-ray exposure showed a marked decrease of the sedimentation velocity, having a so-called post-operative increase before the treatment. A sudden rise of the velocity of sedimentation points to a recurrence: the cases getting well showed a slow return to normal blood conditions. Very similar reactions were seen in the second group. The inoperable tumor patients had a rather short sedimentation time in the beginning, generally increased by the radiation, only

[1] Read by title at the annual meeting of the Radiological Society of North America, at Kansas City, December, 1924.

[2] Minot and Sterling have given a good review (with observations of their own) of the changes of the blood count after radiation, with a rather complete bibliography (The Effect on the Blood of Irradiation, Especially Short Wave Length X-ray Therapy, *Am. Jour. Med. Sciences*, August, 1924, p. 215).

to decrease about three days later. A few experiments—radiating blood in the test tube — demonstrated the fact that it is possible to change the stability of the blood outside of the body.[3] But no rule could be found in all observed changes.

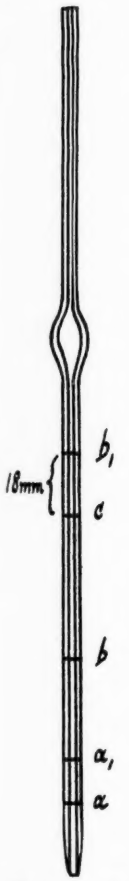

Fig. 1. A capillary, one-half natural size. The marks a and b, a_1 and b_1, are given for different heights of blood column. The tube is filled with sodium citrate up to a respective a_1, then with blood up to b respective b_1. Mark c enables us to record the time for the formation of a plasma layer of 18 mm. height.

The technic[4] of the test is not complicated at all: from 1 to 5 c.c. of blood are required, which are mixed with sodium citrate (5 per cent) in the ratio of 4:1 to prevent the clotting. One c.c. of this citrate blood is filled in glass tubes of 2-6 mm. diameter and the sedimentation of the erythrocytes can be observed. There are two ways to do it; some investigators note the time during which the plasma reaches a height of 18 mm., and others mark the height of the plasma layer after one hour. For very careful studies it is best to record the height of the plasma layer every ten minutes and to plot curves.

Using 1 c.c. of blood requires the puncture of some vein, to which the patient may interpose objections. Therefore, Linzenmeier (12) has worked out a micro-method which can be done with from 1 to 2 drops of blood out of the finger tip. A glass capillary of 1 mm. diameter, bearing several marks to get the right ratio of the blood and sodium citrate, with a widening for the

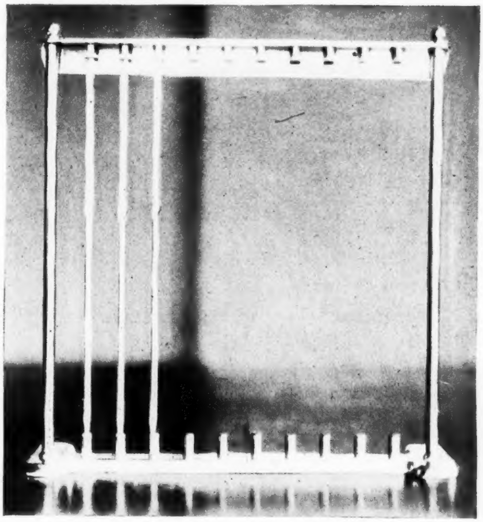

Fig. 2. The microsedimeter.

mixing, is filled and set vertically in a special stand with rubber plates on the bottom and top to guarantee the closure.[5]

A series of tests on normal males and females were done first (Table I) in order to establish standard values. These figures agree well with those published by Gram (13, 14). If the height of the plasma layer is observed and noted every ten minutes, and the result plotted on graphic paper, the three stages of the sedimentation, as given by Rothe (15), are very well demonstrated: the first stage of the slow sinking of the erythrocytes, the stage of "preagglutination"; the second stage of fast sinking, the stage of "agglutination," and the third stage of retardation, the stage of "sacking." The observations of the blood of patients under X-ray treatment were done to answer the following question: Is there any influence of radiation on the sedimentation of the erythrocytes, manifesting itself immediately after the treatment?

Our cases shall be divided into three classes, according to the amount of radiation they received: small doses (skin dis-

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[3] Jaller (Deutsche med. Wchnschr., 1924, p. 1080) could not confirm these findings.

[4] In the meantime, Zeckwer and Goodell (Am. Jour. Med. Sciences, Feb., 1925, p. 209) have given a different technic, used in their investigations.

[5] The whole apparatus, called a "Microsedimeter," is manufactured by F. Hugershoff, Leipzig, Germany.

TABLE I. SEDIMENTATION OF ERYTHROCYTES IN NORMAL PERSONS

	Men	Women
Maximum	6.0*	15.0
Minimum	0.8	1.0
Average	2.7	8.5
Number of tests......	14	12

*Height of plasma layer in mm. after one hour.

TABLE II. CASES WITH SMALL DOSES

Before Treatment*	After Treatment*	Changes**		
3.0	3.0	0		
6.0	6.0	0		
2.5	1.8			—
4.0	2.0			—
8.5	6.7			—
5.5	6.5		+	
3.0	4.0		+	
7.0	6.2			—
4.0	7.5		+	
2.5	4.0		+	
4.0	4.7		+	
2.5	2.0			—
5.5	6.0		+	
3.0	3.8		+	
14	14	2	7	5

*Height of plasma layer in mm.
** 0 = no change.
+ = acceleration.
— = retardation.

TABLE III. CASES WITH MEDIUM DOSES

Before Treatment	After Treatment	Changes		
42.0	39.0			—
11.0	6.0			—
31.0	18.0			—
32.0	27.0			—
17.0	12.0			—
19.0	21.0		+	
10.0	8.0			—
7	7	0	1	6

eases, stimulating effects), medium doses (sterilization, fibroids, Hodgkin's disease, etc.), large doses (malignant tumors).

The result of the findings of the first group are presented in Table II. Most of the cases had skin lesions, treated with unfiltered radiation; in only a few of them has a filter been used. Examining Table II, we see that a small percentage does not show any reaction as far as the sedimentation is concerned; in some cases there is a slight acceleration, and in some a slower sinking of the red corpuscles is shown than before the treatment.

TABLE IV. CASES WITH LARGE DOSES

Before Treatment	After Treatment	Changes		
35.0	31.0			–
27.0	16.0			–
27.0	29.0		+	
17.0	18.0		+	
24.0	28.0		+	
19.0	16.0			–
26.0	18.0			–
32.0	29.0			–
19.0	11.0			–
8.0	6.0			–
23.0	20.0			–
13.0	12.0			–
14.0	14.0	0		
13.0	10.0			–
31.0	17.0			–
20.0	12.0			–
16	16	1	3	12

In the second group, the changes are more pronounced (Table III) and, furthermore, it is evident that the majority of the cases show a retardation of the sedimentation velocity, which is usually higher

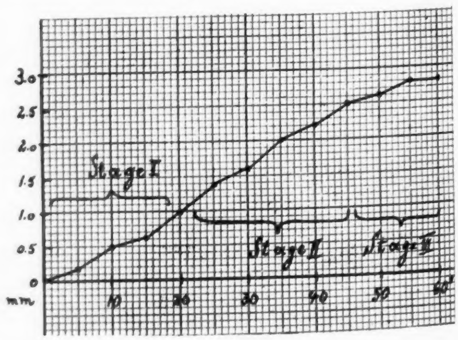

Fig. 3. Sedimentation curve of a normal male. The time is given in minutes, the height of the plasma layer in mm.

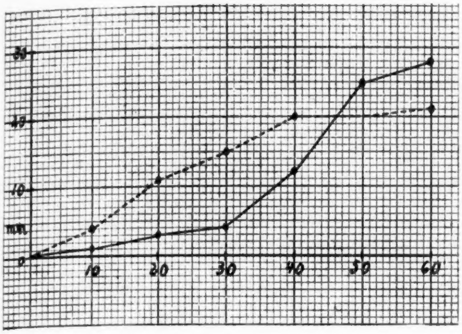

Fig. 4. The straight line represents the test taken before the treatment, the dotted line that one after the exposure.

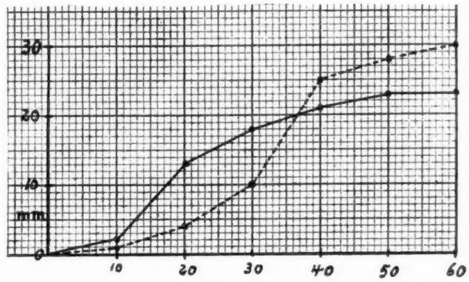

Fig. 5. See explanation below Figure 4.

than normal before the X-ray exposures. This lasts for from three to ten hours, when it is reversed into acceleration again, coming back to normal conditions parallel to the general recovery of the patient.

The third group is a continuation of the second. Although there were cases observed which showed an inversed reaction, the reason for this discrepancy is not known. Most of the malignant tumor cases had a marked acceleration of the sedimentation before the treatment. They responded to the treatment with retardation (Table IV).

A following up of the reaction showed that the retardation turns into acceleration, lasting from three to eight weeks, in cases which are improving; in the event of a recurrence, the acceleration has a tendency to last longer. One is rather impressed that the quantitative change is very much dependent upon the amount of tumor destruction and resorption. This would be only logical, as the blood in the last place has to carry away the detritus of a malignant growth undergoing necrosis as a result of radiation, not to speak of a possible direct effect of the radiation on the blood itself.

Very interesting is the comparison of the curves, demonstrating the sedimentation velocity before and after the radiation. Two examples are given (Figs. 4 and 5). It seems as if the effect of the X-rays would manifest itself in different phases on the sedimentation (Fig. 3): the first reading in Figure 4 would place this patient in the class of acceleration, while further study reveals a definite retardation. An inversed case is presented in Figure 5. I merely want to mention this here, without drawing any conclusion, but as a fact worth while being studied in detail.

SUMMARY

1. It is explained that the velocity of the sedimentation of the erythrocytes gives us a definite idea of changes in the colloidal composition of the blood.

2. Exposure to X-ray causes certain changes in the suspension stability of the plasma; this is made evident by marked variations in the sedimentation test. The observations of other investigators (Risse, Klein, v. Mikulicz-Radecki) could be confirmed.

3. This paper is based on over a hundred tests, but as this is a comparatively small number, it is felt that no rule can be established as to the relations of the findings to the clinical aspect of cases. Further investigations of this phenomenon will be published in a second paper.

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Enlarged thymus.—A decided enlargement of the thymus exists in a large number of newborn infants, and, while it causes no trouble in many, in a few of them it may cause trouble or even prove fatal. The direct symptoms described by Lange, quoted in a recent paper by Pfahler, are "inability to cry loudly, crowing respirations when crying, noisy respirations during sleep, difficulty in nursing, twitching, fretfulness and other nervous symptoms, vomiting or regurgitation, feeble respiration, grunting as though the child wants to have a stool, slow or retarded development, failure to gain in weight in spite of proper dietary measures, inanition, obesity, cough or hiccough."

When the diagnosis of a pathologically enlarged thymus has been made, radiation is the best treatment, as the thymus is the most susceptible to radiation of any structure in the body. The author now uses radium in preference to X-ray, for the sake of more accurate application. He uses 100 mgm. in four capsules of 25 mgm. each, placed one inch apart, and held $\frac{3}{4}$ inch from the skin by a block of pith wood. A filter of 1 mm. of brass is used and the distant side of the radium covered with lead to prevent exposure from that direction. Relief is usually surprisingly prompt. One application of ten hours is usually sufficient, but occasionally this has to be repeated in six or eight weeks. This amount of radiation produces no change in the skin.

W. W. WATKINS, M.D.

Enlarged Thymus: Differential Diagnosis and Radium Treatment. G. W. Grier. Atlantic Med. Jour., May, 1925, p. 502.

Chest conditions.—A clinician with a qualitatively accurate experience will be able, by means of a careful history and examination, to make a diagnosis of pulmonary tuberculosis before signs can be demonstrated on the radiograph. Likewise, a similarly experienced radiologist may be able to make a diagnosis of a condition not noted or suspected by an inexperienced clinician. Radiography supplements the work of the clinician. At the Hamburg State Sanatorium the routine is to make a fluoroscopic examination of the patient in several diameters, and supplement this with a radiograph in all cases where a fluoroscopic diagnosis could not be made with certainty. Then all the clinical evidence is correlated with the roentgen findings.

W. W. WATKINS, M.D.

The Uses of the Roentgen Ray in the Diagnosis of Chest Conditions. John E. Livingood. Atlantic Med. Jour., April, 1925, p. 447.

ORAL ADMINISTRATION OF TETRAIODOPHENOLPHTHALEIN FOR CHOLECYSTOGRAPHY [1]

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WHITAKER and Milliken (1) showed the greater shadow-producing power of sodium tetraiodophenolphthalein over sodium tetrabromphenolphthalein, without a corresponding increase in toxicity. This, together with the recent use of this dye intravenously by Graham, Cole and Copher (2), suggested its use orally.

The same difficulties in oral administration are encountered with both dyes. Both have an unpleasant taste and a tendency to cause nausea and vomiting and both are precipitated in an insoluble form of hydrochloric acid. This leads to the use of some form of coating which is not dissolved in the stomach. Salol and keratin have not been used, because the coating can not be kept of a constant thickness, and also because a pill mass must be made, which would delay the solution of the dye in the intestine. By using gelatin capsules, which have been hardened by formaldehyde, the thickness is always the same, the amount of hardening can be gauged accurately by the time of exposure to the formaldehyde, and the dye is in a form more readily soluble.

The irritating effects are diminished by this, but the capsule gives only a partial protection from the hydrochloric acid, as the gelatin wall acts as a permeable membrane, and some of the dye is precipitated by diffusion inward of the acid. This effect can be shown readily in a test tube with a dilute acid solution, the dye changing from blue to white, as affected by the acid through the capsule wall.

To diminish the diffusion of the acid inward, the dye has been made into a thin paste with olive oil. It is fairly soluble in this, but is more soluble in water, and readily diffuses out of the oil into water. The paste, besides, being a further protection from the acid, carries the dye in a semi-fluid form which is more easily soluble. It is also less of an irritant, as the tetraiodophenolphthalein leaves the oil only in solution.

Capsules of the larger sizes have been used. These are hardened in a closed container over undiluted formalin, sufficient formalin being used to insure that the air above the formalin be saturated with formaldehyde. At first the capsules were exposed to formaldehyde for 24 hours or longer, to insure the protection of the dye while in the stomach. With these, occasionally one would fail to digest, and the examination had to be repeated with capsules hardened for a shorter time. In this way the time of hardening has been reduced to six hours. These have never failed to break in the small intestine, while still hard enough to pass through the stomach intact.

Sodium tetraiodophenolphthalein has been given in doses of 50 mg. per kilogram of body weight, with a minimum of 2.5 gm. Satisfactory gall-bladder outlines can be obtained frequently with doses as small as 30 mg. per kilogram, but it is safer to allow an excess for the patient whose intestinal absorption is poor.

The capsules are distributed through the evening meal, similar to the method of giving the tetrabromphenolphthalein (3). The patient is encouraged to eat a full meal, as the food serves to carry the capsules through the pylorus, dilutes the dye when the capsule breaks, and probably stimulates the gall bladder to empty and give room for the opaque bile. No cathartic or laxative is permitted.

Films are taken the following morning before anything is given by mouth. After

[1] Read before the Radiological Society of North America, at Atlantic City, May, 1925.

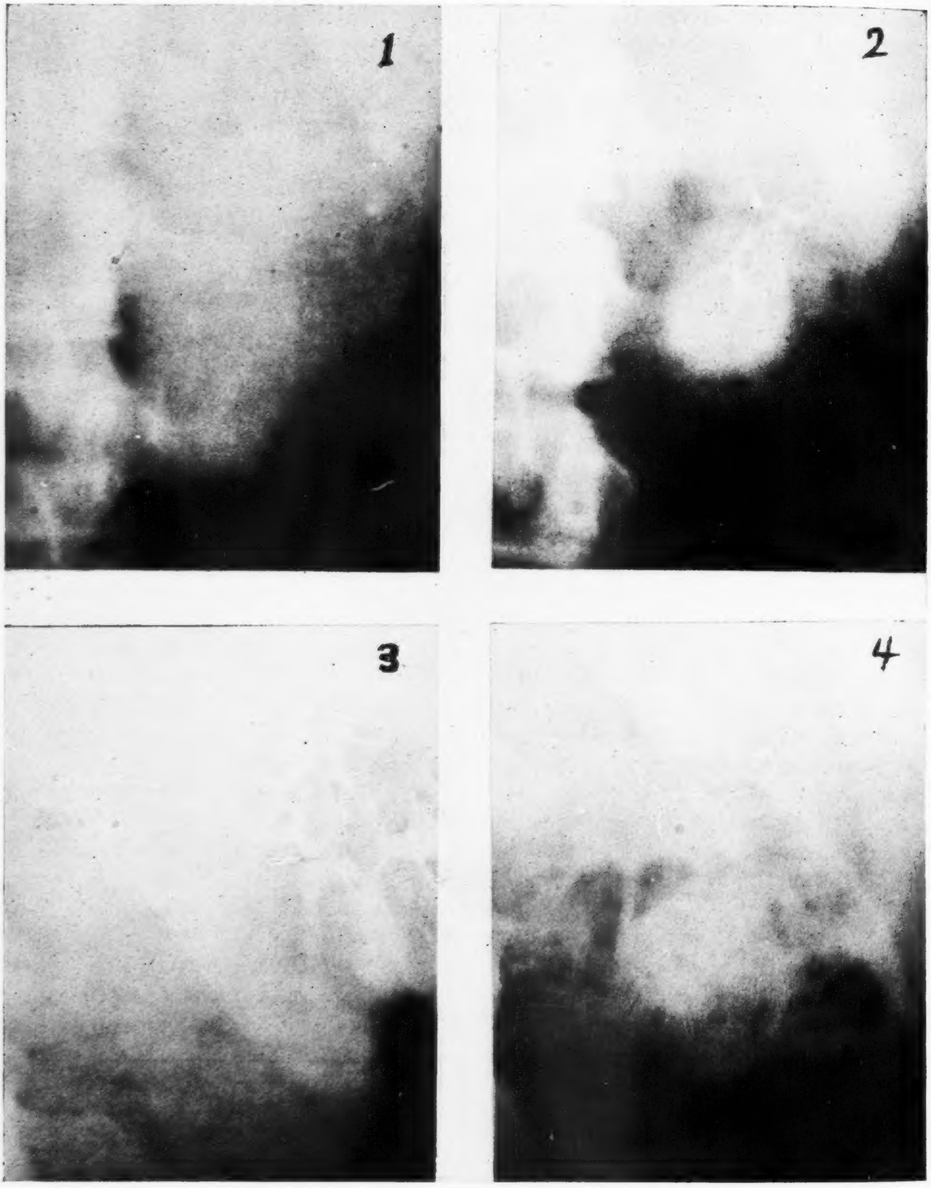

Fig. 1. Filling of a normal gall bladder, following oral administration of dye. (1) Fifteen-hour film showing large and faint outline. (2) Eighteen-hour film following breakfast. The gall bladder is much smaller and the concentration of dye greater. (3) Twenty-four-hour film. Gall bladder has decreased in size and changed position. (4) Thirty-eight-hour film. No dye in gall bladder.

this, the patient receives a general diet. Other films are taken about noon, late in the afternoon, and on the second morning. At least one of these should cover the entire abdomen to show the distribution of the dye in the contents of the colon. This is less important than when the harder capsules were used, but is still a useful check. If there is a uniform increase in density in the ascending colon and hepatic flexure,

showing that the unabsorbed dye is thoroughly mixed with the fecal matter, it gives assurance that the capsules were digested well up in the small intestine, and that no large amount of the dye has been precipitated. If, on the contrary, there are irregular opaque masses in the colon, it indicates either that the capsule has only recently broken or that a considerable quantity of the dye has been precipitated. This would be an indication for a repetition, before a gall bladder could be called pathological from failure to fill. There is always some increase in density in the colon, showing that even under the most favorable circumstances the dye is never completely absorbed.

On the morning films the gall bladder is at its largest and faintest. Following food, there is a decrease in size and an increase in density, in the normal gall bladder. The late afternoon films frequently show a further decrease in size. Normally, there is no dye left in the gall bladder on the second morning.

Fluoroscopy has a limited value. A gall bladder well filled with the dye can be clearly seen with the fluoroscope, particularly in a small individual. Unfortunately, these are usually normal cases.

Sodium tetraiodophenolphthalein has been administered orally 44 times, excluding cases where there was a marked departure from the routine. The symptoms have been milder than with the tetrabromphenolphthalein, and a larger number have had no discomfort at all. Fifteen patients were nauseated, as compared with 25 out of 37 for the tetrabromphenolphthalein. Of these, only 6 vomited, compared with 10 for the bromine dye. Eleven had slight abdominal distress. Headache was complained of 10 times, but was severe but once. Other symptoms were a sense of warmth or flushing, 3 times; dizziness or faintness, 3 times; looseness of the bowels once, and a sour stomach once.

Of the 44 cases, only 6 failed to show dye in the gall bladder. All of these had a history or other findings suggestive of gall-bladder pathology. The only one of these operated on showed a thickened gall bladder.

No physical signs were noted except an increased perspiration in two cases and a flushing of the face in one case. Pulse, temperature, respiration, and blood pressure showed no significant changes. Blood and urine were unchanged following the dye.

Ottenberg and Abramson (4) have recently shown extensive degenerative changes in the livers of experimental animals following injection of tetrachlorphenolphthalein and tetrabromphenolphthalein. While the doses used for this were considerably in excess of the quantity used clinically in cholecystography, their work makes it advisable to use the smallest quantity of the tetrahalogenphenolphthaleins consistent with good results.

The oral dose of sodium tetraiodophenolphthalein, including a surplus to insure absorption, is less than the intravenous dose for small individuals, equals it at 70 kilograms, and exceeds it slightly above that. A considerable fraction, possibly as much as a half, is never absorbed, as shown by the opaque shadows in the colon. This makes it probable that gall-bladder shadows are produced by a smaller quantity of dye by the oral method, giving a larger safety factor.

The oral method is open to criticism because it depends on two variable factors, the digestive and absorptive powers of the patient's small intestine. Poor intestinal digestion may cause trouble by failure to digest the capsule and liberate the dye. This trouble was experienced with the harder capsules, but with the six-hour capsules it has not been observed. When the capsule fails to break, evidence of this is always present on the film, unbroken capsules of the dye being sharply outlined. Capsules, which have recently broken, show a dense mass of the dye, poorly mixed with the adjacent material in the bowel. Thus, if the patient's intestinal

digestion is at fault, it will be demonstrated on the film.

Poor absorption by the small intestine is compensated for in several ways. The less hardened capsules break sooner, and, consequently, a greater length of intestine is exposed to the dye. The semi-fluid consistency of the oil paste allows it to mix more rapidly with intestinal contents, and so favors absorption. Finally, the dose is increased to allow a surplus of the dye. It seems probable that, with these precautions, the oral method will be dependable.

SUMMARY

1. Sodium tetraiodophenolphthalein is a more satisfactory dye for oral administration, because of its smaller bulk and because it gives the patient less discomfort.
2. A gall-bladder outline is produced probably by a smaller quantity of dye by the oral method.
3. The oral method is a dependable one if certain precautions are observed.

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DISCUSSION

Dr. W. H. Stewart (New York): Every man has his own method, and the method that he is most successful in is the proper one for him to use. I have not been so successful with the formaline-hardened capsules as Dr. Menees. We tried them in a number of sinuses, but did not succeed in getting as satisfactory shadows as we did with the paraffin-coated pills. The first thing I would like to take up is in reference to the drug. There is a great difference in the character of the reaction with the different manufacturers of the same drug; not only that, but the same manufacturer may give you a different batch in which the toxicity is much greater than in another batch, so that one has to be careful about a standardization of this particular point. I believe that later on the chemist will be able to give us a product that will be more reliable. I first obtained my drug from the Eastman Kodak Company. We first ordered a small quantity and it proved very successful; then, being fearful we would not be able to get more when we wanted it (I am talking of tetraiodo) we ordered five pounds. We had used, I should think, about two pounds of it when we noted that our gall-bladder shadow was not as great and that the success was not as good, the toxicity having increased. I wrote the Eastman people about it and they did not seem to present any argument. I do not think that their investigations had been carried sufficiently far to be able to decide, but they offered to replace the drug. I am confident that the drug deteriorates and I should advise you, in ordering it, no matter where you get it, to get it in small packages and see that it is not exposed to air and light any more than possible. Mallinckrodt has recently put out the same ampules that they formerly furnished for the tetrabrom and this, I believe, is a very excellent way. The intravenous dose was formerly 5.5 grams of the tetrabrom. They now give tetraiodo in a glass of 3.5, and I suggested to the Eastman people that they put their tetraiodo up in this form of dispensing so you can administer a small dose at a time.

Dr. Pfahler (Philadelphia): Is that the dose you administer?

Dr. Stewart: No, that is entirely too much. It is put up for intravenous injections. Now as to the method of adminis-

tration: When Milliken and Whitaker, from personal experience, suggested using the tetraiodo instead of tetrabrom, even having the same toxicity, but giving the same results with only half the dose, there was a distinct advancement, and enthusiasm started anew. My experience with the tetrabrom had been so disastrous that I was not successful in regaining the confidence of my visiting staff, and they said, "We will permit you to do anything in gall-bladder cases, but we will *not* allow intravenous injections to be given." This was mainly on account of the toxicity,—on account of the case of phlebitis they had. In a recent number of the American Bureau, two cases are reported by Smithies, and two cases of dark necrosis of the arm, in which two drops of solution leaked out into the tissue. That was on their side. On our side, we wanted to perfect a method whereby we could have an office procedure, because intravenous injection is distinctly an institutional procedure, and as there are a large number of gall-bladder cases that come to our office which are not hospital cases, we would like to give them the benefit of this test. The first thing we tried was the jejunal method. I designated it as the jejunal method and Dr. Einhorn suggested it in a case of jejunal feeding; we tested with tetrabrom, but it was not successful. In February we commenced giving tetraiodo through the jejunal tube and were perfectly amazed by the beautiful results obtained from this method. This is also institutional. If the patient is under a jejunal treatment through the tube or the physician is making some biliary tests on the functions of the gall bladder and the character of the bile, etc., it is very simple to inject the solution through the tube already in place. The method is to give the patient 300 c.c. of warm milk at blood temperature at 6 o'clock in the morning, and then at 8 o'clock the tetraiodo is administered. We have learned that we do not have to give as much as was formerly used and the dose in the average 150-pound individual at the present time is 1.75 grams. That is dissolved in 300 c.c. of distilled water and injected in two injections, about a half-hour apart. The remarkable thing about the result is the sequence—now bear in mind that word "sequence," because it runs all through the examination—the sequence of the filling and the emptying of the gall bladder in normal cases was apparently just the same as following the intravenous injection. It appeared that the fourth was the largest; the intensity increased and the size diminished; at the eighth and at the twelfth it was less, and at the twenty-fourth and thirty-sixth hours it had disappeared. This is the normal sequence of the jejunal method. We were all enthusiasm. Presently we found that we had some toxicity in this. Two patients, one an hour and the other an hour and a half after the injection, while going to the bathroom fell in dead faint on the floor. We were then discouraged again, because such an event as that goes like wildfire through a hospital, and the men all came rushing up and said, "No more of that stuff." Dr. Einhorn persists in it, however, and is reducing his dose down to where he claims he will not get toxicity, and we have not as much as we had with our original dose when we gave 2.5 grams; in fact, in some thin individuals we have gone down to 1.5 grams. When I was in Detroit at the middle section meeting of the American Roentgen Ray Society, a paper was sent by Dr. Sosman of Boston, and that, combined with Dr. Menees' preliminary report that he made at that time, stirred us up to the idea of administering it orally. We experimented with saline-coated pills and just the ordinary capsule and formaline-hardened capsules, and we were not so successful as we were when giving keratin-coated pills. We tried to have more than one druggist make them, but were not successful, so that the X-ray department at the present time is a pill factory as well as a record department—we make our own pills. They are made *en masse*, with a little syrup of tolu, the required dose being

usually 40 grains for the average patient of 150 pounds. They are made up in five-grain pills and coated with three coatings of keratin.

DR. PFAHLER: Would you mind writing that on the blackboard. I think it is very important.

DR. STEWART: I will be glad to do it. The advantages of the jejunal method, I think, are as reliable as the intravenous, but we have a reaction and we have a hospital procedure on our hands, and now we want an office procedure. The oral method up to the present time may not be as reliable as the intravenous. I say this generally because I have not been disappointed in the reliability of the oral method except in one case, and I believe that was due to some fault in the technic rather than to the actual drug. It is distinctly an office procedure, which is of great value, and only one case showed a reaction. The case that had the reaction was given the commercial pills, which are coated with stearic acid,—I would like you to see some of these stearic acid coated pills and I will show you how the stearic acid dries up and shells off so that it is not of any use. Those are the keratin-coated pills. You can also coat them with mutton tallow, which will carry the drug through the stomach into the small intestines without breaking them up.

Now a few words as to the preparation of the pill: do not think because you are going to get a gall-bladder shadow that you do not have to use every bit of resource you know of in technic. I was talking with Dr. Carman last night, and I told him that I had to limit my gall-bladder examinations to two a day, with all the others. That was done because of the required skill and time consumed in making these examinations. At least four or five films have to be made of each patient at each sitting, and to put that through our department, with all the other work, is about all we can handle in our capacity. Dr. Carman tells me that he does as many as eight in one day. Of course, it means that his capacity is much greater than mine. The main thing in all this gall-bladder work is suspended respiration. I do not know of anything—this is an old story, you have all heard this thing, Dr. Pfahler talked about it a good many years ago, about different positions and methods, but the main thing in gall-bladder work is suspended respiration. There is nothing that will spoil your detail like that one point. If you turn the patient's head to the left side with a slight inclination, that is done to overcome any shadow that overlaps the spine. I have had two cases of gallstones in the past two months in which gallstones were present and were overshadowed by the spine because the patient turned a little to the left. Gain the confidence of your patient; train him to use your Bucky, and you will get fairly good results.

Now we come to interpretations. We have had with the oral method something like 65 cases, and the shadow has been missing in only four; we have obtained gall-bladder detail in all the others. Great emphasis is laid by Dr. Graham on the non-appearance of the shadow as indicating pathology, and I think he is right in many ways; but it is a very low proportion and many of the positive gall-bladder cases are there without lack of shadow, and you have to recognize pathology by some other method. Dr. Moore writes me that his high percentage of 92.5 per cent was based mostly on the fact of the lack of a normal sequence, and therefore you can see it is a point that must be very carefully observed. You must have a good deal of experience and must observe whether your gall bladder fills at a certain required time, whether the shadow is increased in density or diminished in size, whether it is diminished after food or disappears after certain hours, and any variation, it is claimed, indicates pathology. I have been a little afraid to make interpretations along that line. I am sure some of the men who are favoring the intravenous method will say

that if I had used the intravenous method, then, I would not have that hesitancy, but with the oral method, at least, I still have a little hesitancy. One case had a gall-bladder shadow at thirty-six hours, and I said on that ground it was pathological. It was operated on and proved to be a pathological gall bladder. So if your shadow persists at least thirty-six hours, I think you are justified in saying that pathology is there; at least, it shows a lack of elasticity in emptying power, which no doubt indicates pathology.

In reference to stones, be careful, if you do not get your shadow preliminarily,—and you must always make a preliminary examination. Never fail to make an examination before the dye, because many shadows which are called gall bladders and pathological gall bladders, at that, because you get a shadow, are not gall bladders at all; when you come to give them the test, you will find the gall bladder some way off, and this shadow you have interpreted as indicating a pathological gall bladder is something else. You can use the dye in a check-up, and it is a very important thing. There are two methods by which stones are brought out by the negative shadow. By contrast, the opaque impregnated bile surrounding the non-opaque stone may bring it out as a negative shadow,—in some cases that occurs. In other cases, the surface of the stone absorbs a certain amount of dye and the stone is outlined in that way. It is perfectly fair for us to state our failures as well as our successes, and I may state that in two cases I made a diagnosis of pathology of the gall bladder, one on its tremendous dilatation and lack of emptying power, and the other on its irregularity of shape and its peculiar finger-form, evidencing its lack of proper emptying power, and in both cases the patients had stones. One had six stones and the other had three, and in neither instance had we been able to recognize them. In not all cases are we able to bring out the stones by the dye, because it probably overshadows them, particularly if the stones are movable; if they are fixed and tacked into the gall bladder, we will probably be able to do it. The most important thing to me is the form of the gall bladder and that you can recognize and feel sure of, and every one I have made a diagnosis on has been verified, and that is the most important thing. . . .

Now, it is difficult to get private patients to your office without at least giving them a cup of coffee. Dr. Whitaker is here, and he took exception to my giving coffee and a roll early, at seven o'clock, and I think he is right. I believe you will get better details after twelve hours if you do not give them coffee and a roll, but it is not always possible, with private patients, to have them come from their home to your office and go through all that exertion when they are not feeling well, without some food, and so we give them as light food as possible, and if they can avoid taking any, it is better. My experience does not correspond with Dr. Menees', exactly. At the twelfth hour, we get a shadow which recalls, as a rule, the fourth hour; with the intravenous or duodenal method, it is larger and it lacks the detail we get at the sixteenth hour. At the sixteenth hour the shadow is at its maximum intensity, although it may be literally diminished in size for the oral method. Then at the sixteenth hour (if you begin with the patient at the twelfth hour and the last pill is given at ten o'clock on the evening previous, it will be ten o'clock the following morning, and four hours makes it two in the afternoon) you make your examination. Then give the patient some food,—he can have his regular lunch. Have him come back and you can see what effect food has on the elasticity of the gall bladder. On the following morning the gall-bladder shadow should have disappeared.

Remember, you must not expect the same beautiful photographic effect with the oral method that you obtain with the duodenal or intravenous, but you should and do obtain sufficient for diagnostic purposes. That is my contention. . . .

Dr. L. R. Whitaker (Boston): After one year of intensive study on cholecystography I am convinced that this discovery of Dr. Graham and his associates is one of the most valuable contributions to modern diagnosis. Dr. Graham and many others, including ourselves, have obtained diagnoses which were correct in 90 to 95 per cent of the cases, a much higher average than that obtained by other methods. There is no way of estimating the number of middle-aged women who have been saved a surgical operation by this test, or will have been in a number of years. I will briefly summarize the results obtained at the Peter Bent Brigham Hospital, and I must emphasize that this work has been done by a very close co-operation of practically the whole staff, including most of the house officers, some of the nurses, and many medical students who have volunteered for the test for experimental purposes. Dr. Sosman, roentgenologist, has been very helpful and very co-operative and the success of the undertaking has been largely due to his efforts.

We have not used the bromine salt clinically at all, because it was found in the laboratory for surgical research of Harvard Medical School that the iodine salt, although equally as toxic in the same amounts, was so much more dense that a shadow could be obtained with such markedly smaller doses that the animals suffered fewer symptoms. To further the comparison I took the test myself, both the bromine and iodine salts intravenously at different times. With the bromine salt there was a marked reaction, with vomiting and prostration. The iodine salt produced no symptoms except a slight drowsiness and weariness. We immediately began to use the intravenous injection of sodium tetraiodophenolphthalein clinically and by it have obtained strikingly good results. In 28 cases, proved at operation, the diagnosis has been correct in 93 per cent. Reactions are very rare, indeed. In the last twenty cases just one patient had nausea and vomiting, but that was not severe.

For the oral administration of the iodine salt we have developed, like Dr. Menees and Dr. Stewart, our own method. Numerous ways that have been used to get drugs through the stomach were tried, because the salt is a gastric irritant and it soon became obvious that some way had to be found of getting it through. We tried salol-coated capsules, salol-coated pills, formaldehyde-treated capsules, and one or two other methods. Finally, it became apparent that the problem was not for an ordinary pharmacist but for a manufacturing chemist, skilled in that work, and for this reason it was turned over to Davies, Rose and Company. Mr. Davies has been very much interested in the method and has spent considerable money in trying to perfect it. The vehicle which he now offers is a stearic acid coated pill. It is not yet perfect, as Dr. Stewart has pointed out. The stearic acid has peeled off at times. The pills must be handled with some care; but, on the whole, the latest pills that have been used have been very satisfactory. In the last twenty cases they worked very well, indeed, passing through the stomach without solution and very few have been undissolved in the intestines.

The necessity for good technic must be emphasized. Without it the test is useless. We use the Bucky diaphragm and the regular gall-bladder technic. I must also emphasize, as Dr. Stewart has said, the necessity to watch the salt. Its manufacture has not been perfected. We have employed only that from the Eastman Kodak Company, who are now supplying a much higher grade of product than formerly. We obtained one lot of salt which, by both the oral and the intravenous methods, gave us quite severe reactions. One man, after taking the pills orally, had to go to bed for about two days. That is the only case, however, out of about a hundred and twenty. He had severe nausea, vomiting, and diarrhea. Although with the oral method the reactions are more frequent

than with the intravenous, I personally prefer to take the salt by the oral method because, even though you do get nausea and vomiting, it seems to be of an irritative type which has little effect on the individual, and he feels pretty well after it is over. We have had nausea in about 12 per cent of our cases, vomiting in about 12 per cent, and diarrhea in about the same number. But I do not think that these symptoms are as serious an objection as you might at first suppose, considering the value of the test. Every one of the patients, except the one mentioned, has been able to walk into the hospital for examination the morning after taking the pills.

I want to give you some idea what to look for in this salt in the way of impurity. A good quality of salt is a light blue, finely divided powder, whereas the salt which is likely to be poor will be of a darker blue, more of a purplish tint, more irregular in its consistency, with some larger lumps, and some of those lumps will be of a whiter color than the rest of the salt. Not only that, but when the solution is made, instead of deep dark blue, as it should be, it is likely to be of a violet hue, and this salt will not dissolve as well as the purer kind.

Dr. Menees and Dr. Stewart have given you two very different methods of using the salt orally. It seems to me that if the oral method is going to amount to anything it must be standardized in some sort of way for several obvious reasons. While in the large institution it may be possible to get somebody who will take the care, and it must be great care, that the pills are made right, the average roentgenologist or the practitioner who wants to send his patients to a roentgenologist cannot be depended upon to make the pills or capsules right. That is why we have tried to get a reliable firm to put out the pills commercially.

Dr. Carman has used the bromine and iodine salts orally and thinks the bromine salt is better. He says that he does not get quite so dense a shadow, but has fewer reactions. It may be that orally the bromine salt will finally prove to be superior, but theoretically there is very strong evidence against it on account of its much lower opacity to the X-ray. I am banking on the iodine salt to be superior even for the oral method. You have to give far less of it, and with that lessened dose you probably will not have any more reactions than with the bromine salt.

We place most emphasis not on the reactions, which are never severe, but upon the reliability of the test. I think if you want the test to be reliable, you must give enough of the salt to be sure that even though the patient has a very low absorptive power, there will be enough taken up to give a good shadow and make the result reliable.

The Eastman Company, in agreement with Dr. Stewart, have said they believe the drug does deteriorate. That is a very bad feature and I hope it can be overcome, because if the oral method is going to be used universally, the salt must be put up in some form which can be sent far and wide and will keep for long periods of time. I still believe that the intravenous method is somewhat more accurate for diagnosis, and the reactions are not severe enough to cause any real trouble, although our results with the oral method have recently been very gratifying. I do not think there is any real danger with either method unless used on patients ill enough to be on the dangerous list. I have a few slides which illustrate one or two points, some of which I think are new.

A Member: What dosage are you using for the pills at night?

Dr. Whitaker: We now use one of Davies' pills, which is a five-grain pill for ten pounds of body weight in stout persons and one for twelve pounds of body weight in thin persons. We know that we can get shadows on much less than that, perhaps one-half, but it is a question of the accuracy of the test.

This slide shows distortion of the gallbladder shadow—one point in favor of pathology—and it shows negative areas

through here which indicate stones. This one shows a stone, proved to be so at operation; in subsequent plates it shifted in position,—that is how we were sure it was a stone. Here is a negative area which extends over from the side, which is gas in the colon. You have to look out for that. But that shadow is inconstant in subsequent plates. The next slide is one after the oral method—a gall bladder completely mottled with little fine shadows which at operation proved to represent stones.

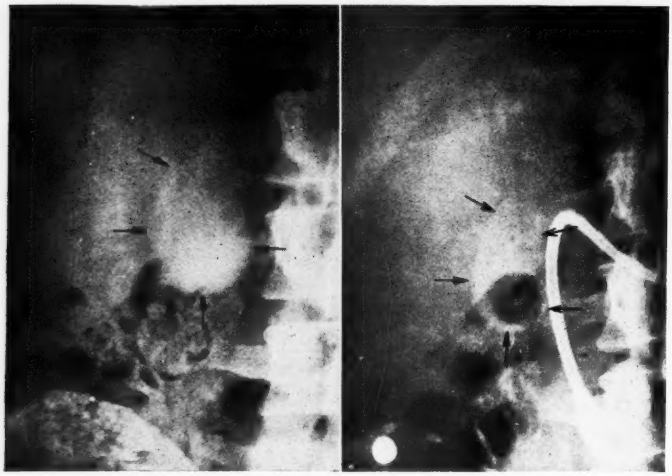

Fig. 1. Oral Method. Normal gall bladder. *Left:* 16-hour film. *Right:* Two hours after intraduodenal injection of magnesium sulphate. Lower end of gall-bladder shadow partly obliterated by gas in the colon. Compare amount of reduction in size of shadow with that in Figure 1. (Not same subject.)

Here is something which is very important and very striking. Dr. Stewart spoke of the reduction in size of gall-bladder shadow after food. We were so forcibly struck by that, in the case of the very first patient who took the iodine salt, that we have investigated the subject pretty thoroughly. After the nine-hour film the gall bladder on this patient was large. Being very hungry he then ate toast with a lot of butter, and cocoa with cream in it. In the twelve-hour plate, the gall-bladder shadow was not more than a third the size it was at the ninth hour. Dr. Graham has pointed out that normally the gall-bladder shadow should remain for about twenty-four hours. All this brought up the question of the effect of biliary drainage with magnesium sulphate. Dr. Silverman and Dr. Menville of New Orleans have published a report of some work on that subject. They came to the conclusion that the gall bladder will shrink down after non-surgical biliary drainage. We have confirmed that, but have also found something else which is very striking. The subjects used were medical students who took the oral method. (There is no question about getting a good shadow by the oral method if you get the technic down right and standardized.) This slide (Fig. 1) shows the shadow before the intraduodenal injection of magnesium sulphate; large gall bladder, normal, however. The next is two hours after the intraduodenal injection of magnesium sulphate, slowly, by which we obtained all the phenomena that Lyon describes. You can see the shadow is smaller after that intraduodenal treatment. The next slide is from a subject, Dr. Edward A. Boyden of Harvard Medical School. Dr. Boyden, several years ago, found that by giving a cat food rich in fat he could make the gall bladder not only shrink in size, but empty

in four to six hours from a distended state to one of collapse containing only three or four drops of very stringy, concentrated bile. This agrees with our finding that food rich in fat produces a marked shrinkage in any way it could be taken care of in that length of time except through the cystic duct.

In a number of cases we have obtained a much more marked reduction in size of the

Fig. 2. Oral Method. Normal gall bladder. *Left:* 16-hour film showing a large homogeneous shadow (except for gas in intestine) with a regular outline. *Right:* Note the tremendous reduction in size of the shadow 1 hr. 40 min. after taking food rich in fat (egg yolks and cream).

size of the gall-bladder shadow. The slide (Fig. 2) shows a large gall-bladder shadow. The next slide shows the same subject after taking what we call the Boyden meal (four egg yolks and one-fourth to one-half pint of cream). Such a tremendous reduction in size of the shadow after one hour and a half must indicate that most of the bile has been thrown out, in all probability through the cystic duct. I do not see how shadow after the patient has taken food rich in fat than after the intraduodenal injection of magnesium sulphate. This finding reflects a good deal of doubt upon the value of non-surgical biliary drainage by magnesium sulphate. Why subject a patient to the discomfort of a duodenal tube, if you can drain the gall bladder better by giving him bacon and eggs in the morning?

RECENT ADVANCEMENTS IN CHOLECYSTOGRAPHY [1]

By WILLIAM H. STEWART, M.D., MAX EINHORN, M.D., and ERIC J. RYAN, M.D.,
NEW YORK CITY

THE February, 1924, issue of the *Journal of the American Medical Association* contained an article entitled, "A Preliminary Report on the Roentgenographic Examination of the Gall Bladder; A New Method Utilizing the Intravenous Injection of Tetrabromphenolphthalein Sodium Salt," by Drs. E. A. Graham, W. H. Cole and G. H. Copher of St. Louis. While investigating tests to ascertain the function of the liver, the discovery was made that when certain drugs were administered intravenously the bile became opaque to the X-ray, causing the outline of the gall bladder to be clearly defined. Different dyes were used experimentally, the outcome being that the tetrabromphenolphthalein sodium salt was found to be the most practical for routine use.

This discovery was received with enthusiasm by all the roentgenologists throughout the world. Up to this time the roentgen diagnosis of gall-bladder lesions had not been satisfactory. In a fair percentage of cases, if special attention were paid to technic, gallstones, pathological gall bladders and adhesions were recognized, but a considerable proportion remained that could not be detected.

With this new method we are now able to not only discover the pathology present, but, in addition, to give some definite data as to the size, shape, location and emptying power of the gall bladder, and of no small importance is the ability to study the function of the liver, recognizing delay.

The greatest achievement is the fact that gallstones which are non-opaque to the X-ray, when surrounded by this opaque bile are outlined by negative shadows which can be readily recognized. In some cases the surface of the non-opaque stones absorbs a sufficient amount of the dye-impregnated bile to become visible in the roentgenograms.

It was early recognized that if, with no fault in the technic, the gall-bladder shadow did not appear at any time during the frequent necessary X-ray examinations after the injection, that fact was due to one of the following reasons:

Fig. 1. Jejunal Method: Correct position of the tube before instillation of the solution of tetraiodophenolphthalein.

A. *In Cases without Obstructive Jaundice*

1. Obstruction of the cystic duct due either to stone or stricture. This includes cases of hydrops or empyema of the gall bladder.

2. Obliteration of the lumen of the gall bladder due to shrinkage or tumor growth or packing with calculi.

[1] Read before the New York State Medical Society, Syracuse, N. Y., May 13, 1925.

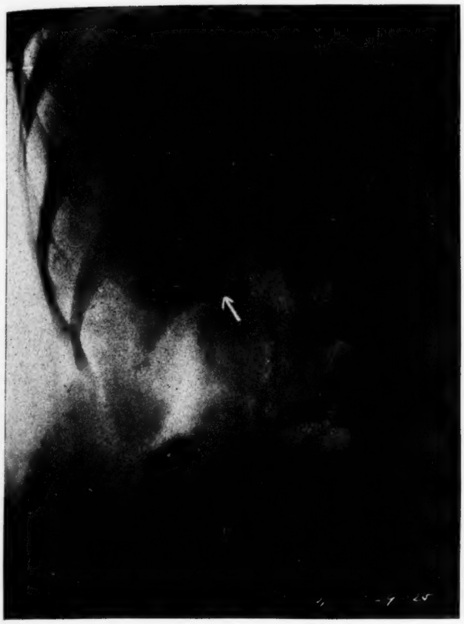

Fig. 2. Jejunal Method: Eight hours after the instillation of tetraiodophenolphthalein into the jejunum through the tube. Note elongated gall bladder. It is curved upon itself and bound down by omental adhesions. Operation confirmed the findings.

Fig. 3. Jejunal Method: Eight hours after the instillation of tetraiodophenolphthalein into the jejunum through the tube. Enlarged dependent gall bladder. Fluoroscopically it was found to be freely movable.

3. Thickening of the walls of the gall bladder with insufficient lumen and bile content to cast a shadow.

4. Unusual thickening of the contents of the gall bladder (bile mud) so that it cannot mix with the recently excreted bile from the liver containing the test medium.

5. Defective liver function, with imperfect excretion of the opaque bile.

Theoretically in all other cases *without* obstructive jaundice the gall bladder should be visualized.

B. In Cases with Obstructive Jaundice

1. Shrunken, contracted and empty gall bladder found, according to Courvoisier's law, in the chronic intermittent form of obstruction produced by a calculus in the common bile duct.

2. Obstructions above the junction of the cystic duct with the common duct with no bile filling of gall bladder, as, for example, in carcinoma of the hepatic duct or carcinoma of the hilus of the liver.

3. Excessive distention of the gall bladder with bile, in common bile duct obstruction, due, for example, to chronic pancreatitis, carcinoma of the head of the pancreas or carcinoma of the papilla of Vater, so that the admixture of the test medium is too dilute to cast a shadow.

4. Arrested liver function in cases of very protracted and intense chronic obstructive jaundice due to any cases where, by continued back pressure in the biliary system, not even the normal bile is excreted into the bile ducts or gall bladder and so-called "white bile" is found at operation.

Therefore, in cases with obstructive jaundice the gall bladder would most likely be visualized when the jaundice is due to a chronic progressive obstruction at or near the papilla of Vater produced by a chronic pancreatitis, carcinoma of the head of the pancreas or carcinoma of the papilla, or when it is due to the more acute form of

Fig. 4. Oral Method: Twelve hours after forty grains of tetraiodophenolphthalein by mouth. Enlarged deformed gall bladder, the result of adhesions.

Fig. 5. Oral Method: Twelve hours after forty grains of tetraiodophenolphthalein by mouth. Small deformed gall bladder, the lower portion turned upon itself and bound down by adhesions.

calculous obstruction, provided the distention of the gall bladder has not been too extreme.

The shadow of the normal gall bladder following the intravenous injection of tetrabrom should appear at the fourth hour, show diminished size and increased intensity at the eighth hour, become more intense in detail and less in size at the twenty-fourth hour and disappear thirty-six hours after the injection. Any variation from this sequence is strongly suspicious of pathology.

Largely due to these positive findings the use of the test became general. Soon, however, objections were advanced against the method, the most serious being the severe toxic symptoms which developed in many cases almost immediately after the intravenous injection. These consisted of flushing of the face, dizziness, headache, vomiting, faintness and collapse. In some patients the condition seemed critical; nevertheless, they revived quickly. Some stated that they felt as well after as before the injection; others suffered from severe headache and nausea for twenty-four hours. So far as we have been able to ascertain, no deaths have been reported.

Efforts were immediately made to overcome these toxic symptoms. The usual dose of 5.5 grams of the tetrabrom was administered intravenously in two doses instead of one, fifteen minims of 1-1000 solution of adrenalin was given just before the first dose, and if there was much flushing of the face, five minims more were given before the second injection. The technic was also much improved, only freshly distilled water being used and the injection given slowly in the recumbent position by the gravity method instead of by a syringe. The preparation of the patient was improved upon, food being withheld for about twelve hours before the test. More care was exercised in the selection of the cases. Patients with cardiac lesions were not allowed to submit to the proce-

Fig. 6. Oral Method: Sixteen hours after forty grains of tetraiodophenolphthalein. Large dilated elongated gall bladder, the tip of the fundus below the level of the crest of the right ilium. Note the increased liver shadow. The lower pole of the right kidney can be seen above.

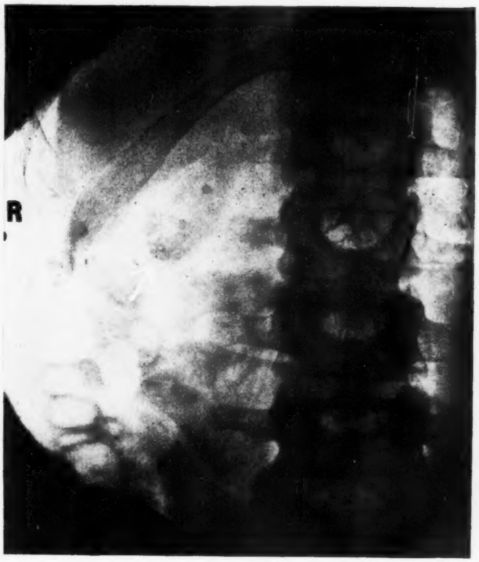

Fig. 7. Oral Method: Sixteen hours after forty grains of tetraiodophenolphthalein by mouth. Medium size gall bladder with numerous stones in the lower portion. At operation a pathological gall bladder containing a number of small stones was found. The common duct was considerably dilated and contained two stones. The authors are of the opinion that these stones were displaced from the gall-bladder group after the roentgen examination.

dure, nor were highly hysterical or nervous patients considered desirable subjects.

Despite these precautionary measures reactions occurred, some quite severe. This was sufficient to discourage the use of the test so that the procedure in many of our larger institutions was discontinued. However, a few, recognizing the importance of the roentgenographic visualization of the gall bladder, continued using it.

In the January, 1925, issue of *Surgery, Gynecology and Obstetrics,* Drs. Lester R. Whitaker and Gibbs Milliken, of Boston, published an article entitled, "A Comparison of Sodium Tetrabromphenolphthalein with Tetraiodophenolphthalein in Gallbladder Radiography." They stated that while tetraiodo was equally as toxic as tetrabrom, the increased atomic weight of the iodine radical in tetraiodo over the bromine in the tetrabrom rendered it possible to obtain the same roentgenographic results with one-half the dose and, in consequence, less reaction. Their deductions were so plausible that the test was again taken up with renewed enthusiasm. Observations showed that their statements were true. Patients did not have as severe reactions from the smaller dose of tetraiodo as had been observed following the use of the tetrabrom. A recent article by Drs. Graham, Cole and Copher accepts the advantage of the tetraiodo over the tetrabrom and advocates the routine use of the iodine salt (1).

Even with the conceded advantages of the tetraiodo there still remained an occasional unfortunate toxic experience with the intravenous injection and the enthusiasm was suspended.

In February of this year (1925) the authors began to administer the tetraiodo into the jejunum through the duodenal tube. It was found that in the average patient only 2 to 2.5 grams of the dye were required to satisfactorily outline the gall

bladder. The tube was inserted at night, and in the early morning the exact position of the tip was ascertained fluoroscopically; if it was well down in the jejunum, the tetraiodo, dissolved in 200 c.c. of freshly

Fig. 8. Oral Method: Sixteen hours after forty grains of tetraiodophenolphthalein by mouth. Starvation diet. Note size, shape and intensity of gall bladder.

distilled water, was slowly injected, usually in two doses, until the full amount had been given. Roentgenographic observations were then made four, eight, twenty-four and thirty-six hours after the administration. As a rule, the normal gall bladder was outlined as beautifully and regularly and showed the same time for filling and emptying as with the intravenous method. One must be certain, however, that the solution is injected well down in the jejunum; otherwise there will be a regurgitation into the stomach, with vomiting. Recently articles by Drs. Samuel Weiss (2) and Israel O. Palefski (3) have appeared advocating this method.

While in a number of ways the jejunal method was found to be superior to administering the dye intravenously, it was far from harmless, many patients having severe reactions about an hour after the injection. In short, it was still a hospital procedure.

Investigations made by the authors, supported by results reported by Dr. M. Sosman, of Boston, and Drs. T. O. Menees

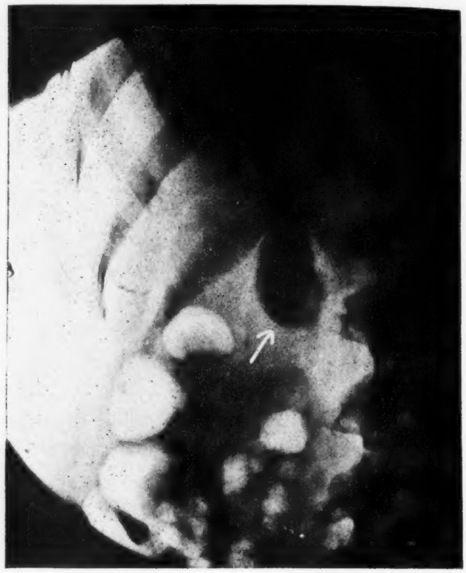

Fig. 9. Oral Method: Same case as Figure 8. Fifteen minutes later, after a chicken sandwich and a glass of milk. Note the effect of food. The size is diminished, the intensity increased and the shape contracted.

and H. C. Robinson, of Grand Rapids, convinced us that the drug could be given by mouth, and satisfactory results achieved thereby. Considerable experience has confirmed these deductions. We now routinely use the oral method in all cases referred to our office for the roentgenographic examination of the gall bladder. The method of procedure is as follows:

After a thorough cleansing of the intestinal tract and a light breakfast, a preliminary roentgen examination of the gall bladder is made in the regular manner at about 10 A. M. The usual lunch is then allowed. At 5:30 P. M. a light meal is advised, consisting of vegetable soup, a baked potato, bread and butter and a cup of coffee, tea, cocoa or milk. Forty grains of the tetraiodophenolphthalein having

been *freshly* made into eight five-grain pills and well coated with keratin, the patient is instructed to begin at 9 P. M. and take two pills with a wineglass of water every fifteen minutes until all are taken. At 7 A. M. the following morning, a cup of coffee and one roll are allowed. At 10 A. M. a complete fluoroscopic as well as roentgenographic examination of the gall-bladder region is made. Four hours later, at 2 P. M., the examination is repeated. Regular lunch is served at 2:30 P. M., followed by another X-ray examination at 4 P. M. The patient returns the following morning for a final observation.

It is essential to make the preliminary examination before the administration of the tetraiodo for we believe that a visible gall bladder found with the ordinary method is frequently an indication of pathology. The "test" can be used as a check on these findings, for fictitious shadows have more than once been erroneously diagnosed as a diseased gall bladder.

The starvation diet is necessary in order that the gall bladder may become distended with the opaque bile. In normal cases it should appear at the twelfth hour and should slightly diminish in size and become more intense in outline four hours later. As soon as food is given it commences to contract and to empty itself, as shown by the diminution in size and detail of the shadow. This observation is to be made during the examination at 4 P. M., after lunch. The following morning thirty-six hours after the tetraiodo, the shadow of the gall bladder, unless pathological, should have disappeared.

So far, our patients submitting to the oral method, fifty-three cases in all, have had no severe reaction. These have been seen at our private office, Lenox Hill and Lutheran Hospitals, New York City. About 10 per cent had a vomiting attack and 5 per cent a mild diarrhea. The majority misinterpreted the use of the pills and claimed that they did not even move the bowels. In only four cases out of the series in which the tetraiodo was given by mouth, did we fail to obtain a gall-bladder shadow. In addition, nearly all showed increased liver detail, especially of the lower border, a most important anatomical "landmark" in the interpretation of the roentgenograms.

We are convinced that the oral method is the safest and best. It is more than likely that in time it will prove to be as reliable in the roentgen investigation of the gall bladder as bismuth and barium are in the gastro-intestinal tract.

It is well to bear in mind, however, that the method, to be of practical value in the diagnosis of gall-bladder disease, must confirm and support the clinical findings. This can only be accomplished by a close co-operation between the surgeon or internist and the roentgenologist.

We are indebted to Dr. DeWitt Stetten, of New York City, for suggestions in the preparation of this paper.

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PRACTICAL *VERSUS* THEORETICAL APPLICATION OF HIGH VOLTAGE X-RAYS AND RADIUM[1]

TECHNIC LEARNED AND RESULTS BEING GOTTEN AFTER THREE YEARS' PRACTICE AND OBSERVATION

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IN the practice of medicine, as in other arts and sciences, to some it is given to lead, to others to follow; to some is the opportunity given to map out the theoretical, technical and scientific aspects of the problem, while to others of us falls the lot of artfully adapting the dictum of theory and fact to the solution of the problems at hand, confirming such teachings or proving them impractical.

The writer's energies have been directed wholly to the practical uses of radiation therapy, an effort trying, and at times discouraging, when confronted with the facts, theories and dreams which have so tended to confuse as well as clarify the situation. To unravel, assort and logically arrange these facts and theories is an Herculean task; to fit them in and demonstrate them practically is an impossibility. Hence those minds with the inherited tendency to think for themselves may be pardoned when they wander from the path laid out for them and presume to speak from their own limited experience and in language shocking to the ultra- or pseudo-scientist.

When the lightning-like flashes of high-voltage electricity began to leap across our horizon a few years ago, and seemed to give promise of illuminating the darkest recesses of radiation knowledge, my mind wandered back to the year 1904, when, in the rural section of southern Louisiana, I saw my twelve-revolving-plate static machine speeding under the power of a snorting gasoline engine, and wondered if that power which shot those sparks across an air gap of 12 to 16 inches, was not the same force—only made greater and bigger and stronger in the resurrection. Such, it seems, was and is the case. And my second thought was: Does the bigness, the greatness and strength of this force solve our problems, or will there develop the greater problem of controlling, measuring and directing its energies? Again, it seems, our thought was prophetic, for it appears now we are all agreed that the methods of measuring and directing radiation intensities have done more to advance radiation therapy than has the manufacture of high-voltage X-ray machines.

In the practical application of X-rays we accomplished just as satisfactory results years ago when operating with medium voltage as we have in more recent years with the higher voltages. This is but a practical proof of the scientific fact that biologic action is more proportionate to the quantity than to the quality of radiation. The practical problem has been to determine the relative quantity of radiation delivered to, and produced in, the tissues and the effects produced by these quantities on the different pathologies. The methods of measuring radiation, now familiar to us all, have partly solved this problem, and have, further, demonstrated that a given quantity can be delivered more accurately, more constantly, and more easily with high than with low voltage. This, to our mind, constitutes the one and only advantage of high voltage.

Immediately following the birth of high voltage apparatus we had handed out to us in stock form and quantity production certain figures, twists and curves which we were told solved the rest of our problem, and by only a glance we would see the necessary dose to annihilate the sarcoma and put to utter rout and defeat the carcinoma army. Again the inquisitive and skeptical mind asks pardon for having presumed to question certain figures as

[1] Read by title before Radiological Society of North America, at Atlantic City, May, 1925.

well as statements and for hesitating to follow the devious ways and dangerous curves which bore no warning signal—"Go slow."

Immediately on installing our high-voltage apparatus, three years ago, we secured an iontoquantimeter and demonstrated the quantity of radiation we were producing and also what we had been producing with our previous apparatus. This gave us a comparative idea of how far we could go and what we could do. After a short period of checking and correcting, a technic at least safe was devised. Our first disappointment was in not being able to deliver the deep doses claimed by some, and, next, in finding carcinoma cells so presumptuous as to defy the 110 per cent erythema dose. After securing data as to the amount of radiation being delivered and produced at various depths, we soon observed that the pelvis would tolerate at least one-third more than an erythema dose and that in the majority of cases this amount was necessary to cause recession of the malignant tissue.

We still use the word "erythema" and work in terms of an erythema dose, just as a great many others with a real patient at hand, though they may frown upon and declaim against its use in the convention hall. We may talk in terms of various and sundry units, some of which may be more intelligible than others, but the fact remains that, whatever unit is used, we must know just how many our patient's skin will tolerate and how many our pathology will not tolerate. We know that a sarcoma cell is more vulnerable to radiation than a carcinoma cell, and that there is a varying susceptibility among the different types of carcinoma. These facts have led some into a vain effort and what the writer is convinced is a dangerous practice—of attempting to prescribe a specific dose for the various types of malignancy. The effort is commendable, but in our present stage of development the practice is hazardous to the patient.

Theory is essential to the development of knowledge; its study is fascinating and, with some, intoxicating. Anatomical drawings picturing a volume of radiation shot into a pelvis, seemingly endowed with a special sense of accumulating at certain designated cell nests and ignoring others at the same and varying levels, are misleading and dangerous, especially to those who accept text as being inspired.

We frequently yet hear the hackneyed expression, "Every case should be studied and given a special technic." We feel we are not deserving criticism when we say that this is only partly true; all of our cases are studied, but, once we are satisfied that malignancy exists, a given case gets the same technic as do all others, and that technic is the delivery of the maximum amount of radiation from which the normal cells will recover.

We know no sarcoma or varying type carcinoma cells. We believe them all to be outlaws, with the same malicious intent, and they should be electrocuted with a voltage and amperage which will permit of no resuscitation. The surgeon's guillotine frequently accomplishes the desired result, but only when the whole outlaw band is corralled. As nearly always happens, guilty accomplices lie skulking in nearby obscure corners which only radiation can safely penetrate, and then with safety only when the maximum dose is given.

Malignancy discretely distributed has always shown itself more susceptible to radiation than when appearing in mass form, hence in those cases of massive areas with outlying zones of lesser involvement, such as are constantly seen in carcinoma of the cervix and breast, it has been our practice to thoroughly irradiate the whole field with X-radiation and later attack the central or massed area with radium. In our early experience, we made the mistake of attempting to use the two agents at the *same time*, which resulted in an over-radiation in some areas, and an under-radiation in others. To-day we are applying our maximum X-radiation, and *later*, after all

reaction has subsided, using radium radiation to the central, or densely involved, zone.

The intensity of radium falls away so rapidly from the point of contact, X-rays so slowly, that it is impossible to apply the two at the same time and secure uniform effect. In making this statement I am not ignorant of what has been claimed and the beautiful diagrams which we see, showing how simple and easy it is to apply the two agents at the same time and get just the right dose in just the right place. Our first year's experience convinced us this technic was wrong. During the last two years we have settled to the practice in all cases of pelvic malignancy of administering to the whole pelvis an X-ray dose at least one-third greater than our erythema dose, which is an erythema just short of vesication. This will occasion annoying symptoms for a few weeks in some cases; but after six to eight weeks in a great many, the malignant mass shows marked retraction, the tissue is less engorged, bleeds less freely, discharges cease and a general improvement is noted. Quite frequently in very elderly women it has entirely cleared. At this stage, regardless of local appearances, radium is applied in from twenty-four to forty-eight hundred milligram-hour doses.

This plan appeals to us as being rational and scientific, the X-ray dose corralling the outlying cells, staying their division, limiting the lymphatic and blood supply, and stimulating fibroblastic action, thus throwing out, as it were, a barrage, after which the main stronghold, now weakened, is exploded with a radium bomb, more powerful but of less range.

We must hold always in mind whether a given case is to be treated for an expectant cure or for palliation. If a true metastasis has taken place, only palliation can be expected. To study out the lymphatic supply, diagram it, and then proceed to a bombardment of each and every supposed infected gland can work only harm.

With this premise in mind we have reasoned that X-rays should be as accurately directed as possible and only necessary areas irradiated, using as small ports as are compatible with delivery of the desired dose. Our installation is, therefore, of the overhead tube stand type, which enables us to angulate tube and posture the patient to the best advantage. The practice of treating through holes in the wall with fixed tubes is convenient, but, to say the least, difficult in the way of securing accuracy. We have been and are still working on the hypothesis that maximum —or, if you will, lethal—doses should be administered in all cases of malignant disease. However, in a few cases where we have been forced into a smaller, prolonged dose technic results have shown better than expected.

We have appreciated the fact that the defensive forces must be nurtured, as well as the invading elements destroyed, but believe the latter is now our greater problem.

We have simplified our technic in an effort to master it more easily and learn its merits as well as demerits. Operating with 200 kilovolts, half a millimeter copper filter, 20 inch distance and 3 milliampere current, we have varied our time and portal entries only to secure the proper dose. To constantly vary all factors tends but to make us less proficient in each combination used.

From March 24, 1922, to March 24, 1925, we have treated by high-voltage X-rays and radium 641 cases in which the pathology was beneath the skin; of which number 244 were carcinoma of cervix and uterus (38 being post-operative), 127 carcinoma of breast (45 being post-operative), 125 fibroma and metrorrhagia, 7 carcinoma of stomach, 14 carcinoma of prostate. The remaining 124 were irregularly distributed, involving the mouth, esophagus, mediastinum, lungs, liver, pancreas, colon, testicle, ovary, etc.

In comparatively few of these cases were biopsies made; in practically all competent

clinical talent was at hand. Our experience from a statistical standpoint is worthless. Whether any of our cases of malignancy have been cured remains to be seen; however, a gratifying percentage, considering the material handled, gives promise of being permanently benefited.

We have been influenced by a sense of duty, personal interest and a sincere desire, dominant over all, to benefit our patients, and have not viewed them simply as scientific curios. In this we may have erred, and to the profession generally our work is no doubt worthless, but to us it has been invaluable and from it, we believe, the following conclusions may be drawn.

CONCLUSIONS

1. Carcinoma or sarcoma, after true metastasis, is incurable.
2. Generalized radiation in an effort to reach all supposed metastatic areas is futile and hazardous.
3. Regardless of the type of malignancy, the maximum radiation from which the surrounding tissues will recover should be applied.
4. In most cases radium and X-radiation prove most effective.
5. Uniform radiation is not practical at any depth by radium and X-rays applied at the same time.
6. Malignant cells, when discretely scattered in normal tissue, yield to less radiation than when in mass.
7. X-rays should be directed with accuracy in all cases and as small ports as possible used.
8. Erythema dose, with treatment factors given, is our most practical unit.
9. Installations permitting of accurate posturing of the patient and angling of the tube are most desirable.

X-rays in otolaryngology. — In regard to the value of X-rays in diagnosis, the writers believe that it is probably the most useful laboratory adjunct in the history of medicine. However, the X-ray findings are often at variance with clinical manifestations, and in such instances one must not lean entirely upon X-ray interpretation. The rapid advancement of laryngology as a special field in medicine, has, no doubt, in a great measure been due to the use of the X-ray in diagnosis.

As to its therapeutic value, the results do not warrant an optimistic view. The results of X-ray treatment in malignancy have been disappointing. Cures from its use are few and far between. Occasionally such treatment will change an inoperable into an operable case, but only rarely so. The writers state that in their experience they had never seen a single case of true carcinoma cured. In sarcomata they have seen good results in a small percentage of cases. Some few patients have completely recovered and thereafter have been free from recurrences. In papillary and surface epitheliomas excellent results are obtainable, but in these conditions the X-ray is not a specific. In treating hypertrophied and diseased tonsils, while the size may be decreased by destruction of the lymphoid portion, no relief has even been obtained from the general symptoms due to a focal infection. In deafness, the authors have had absolutely negative results.

SOLOMON FINEMAN, M.D.

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RADIO-ACTIVE SUBSTANCES AND THEIR THERAPEUTIC USES AND APPLICATIONS

RADIOTHERAPY OF CANCER OF THE UTERINE CERVIX

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I. HISTORICAL

CANCER of the uterine cervix was one of the first malignant lesions to be offered the curative effects of radium therapy, and throughout the history of the application of Madame Curie's discovery to the practice of healing, the alleviation of this, perhaps the most-to-be-dreaded of all the ills which afflict her sex alone, has occupied the attention of the greater part of those who have aided in the development of this particular branch of science. The history of the radiotherapy of cervical cancer is the history of radiotherapy itself, but, in spite of this, there is perhaps no department where the value of radiologic treatment has been so often questioned, and none where, even today, so many stand ready to assert that the work which has gone before is of very doubtful significance.

The discovery and therapeutic application of radium was a French achievement, while that of X-ray must be credited to Germany. It was in these two countries, therefore, that the history of this form of treatment for malignant neoplasms took its rise and was brought to a relatively high state of perfection before conservative minds in English-speaking countries could be brought to regard these new agents wholly without distrust. As early as 1907 French women were being given the benefit of the doubt which still prevented their English-speaking sisters from sharing in the alleviating effects of this remarkable physical agent, but it was not until 1913 that the "Weekly Board" of the Middlesex Hospital, London, sent two representatives to Paris to study the methods of cancer treatment which were then being employed by Madame Curie, Becquerel, Dominici, Degrais and others. The result of this visitation was the attainment of 435 milligrams of radium bromide for use in the cancer department of this hospital, and —more remarkable still—the realization by the Board "that the new developments of the radiation treatment of cancer and the care of their valuable stock of radium required technical skill of the highest kind." They therefore decided to appoint a whole-time physicist (the first appointment of the kind ever made in any hospital). It was considered that the physicist, though not himself a medical man, would bring essential help to his medical colleagues in the solution of their problems.

In the United States, also, many medical men, and gynecologists especially, had begun to investigate eagerly the possibilities of palliation and cure of uterine cancer by means of radio-activity, but it was not until two years had passed—in 1915—that we find any formal notice that the new therapy was being seriously considered by those whose opinions carried weight in the highest places. It was in that year that Howard A. Kelly presented before the American Medical Association, and, later, to that even more conservative body, the American Gynecological Society, an account of the work done with radium in carcinoma of the uterine cervix, which he had been carrying on in association with Curtis F. Burnam for some six years. It is hard for us to realize that only ten years have elapsed since it was considered necessary to preface such an account by a description of the physical properties of radium and the reasons for believing that it had value in the treatment of malignancy, when the audience he was addressing was made up of the foremost gynecologists in the country.

Yet, even then, much had already been accomplished toward the improvement of the outlook, both for cure and life-expec-

tancy, of those afflicted by uterine carcinoma, for whom, in the immediate past, the prospect had universally been so dark. We find Burnam, addressing his fellow alumni at the quarter-centennial of the Johns Hopkins Hospital, saying: "In cancer of the cervix uteri and of the vagina most remarkable results are possible. The hard scirrhous cancer of the cervix is the most resistant type, and the cellular, slow-growing medullary carcinoma, especially that which tends to spread over the vaginal wall, is the most favorable. It is easily possible to radiate away metastases in the vagina without interference with the integrity of these viscera. A large inoperable carcinoma fixed to either pelvic wall can, within a few weeks, appear clinically healed, and some of these patients stay healed for at least several years. When healing does not occur there is almost invariably improvement in the general condition, bleeding and discharge cease, and pain is diminished or disappears. There can be no question that radium is a great boon to patients suffering with inoperable and recurrent cancer of the cervix uteri. It is equally certain that its use in operable cases, along with operation, will greatly increase the number of permanent cures." He added, however, that "it is still uncertain whether operable cases should be treated with radium alone."

The attitude occupied by these two men, who may be regarded as American pioneers in the extended employment of radiotherapy in uterine cancer, at the period now under consideration, was well summed up in their address to the American Medical Association, when they said: "Our knowledge of the curative action of radium on cancers of the uterine cervix and vagina is as yet in its infancy; nevertheless, its ultimate possibilities, viewed in the light of present experience, seem very great. That it does greatly increase the percentage of curable cases of these cancers and correspondingly diminishes the percentage of the incurable is already evident and demonstrable."

From this time onward the use of radium in the treatment of cervical cancer became increasingly common, and the knowledge of the possibilities offered by the employment of radio-activity in combating this especial form of malignancy was quickly disseminated. So rapidly did this change of attitude take place that in 1921 we find Boggs complaining that "the brilliant results of radium in the treatment of carcinoma of the cervix and uterus are drawing many into this field without training, as may be expected, and, consequently, poor technic and judgment are bound to react. It is just as necessary to develop a radium technic as a surgical technic, and for some time to come the best end-results are bound to be produced by those who have studied every detail, checked up by a large number of cases, and compared details and results with a large series of cases treated by others."

Although the intervention of the Great War in large measure diverted the attention of the medical world from such questions, it did not check the growing enthusiasm in regard to radium as a curative agent in cervical carcinoma. The literature of that period is full of accounts of successes, both with radium alone and as an adjunct to previous surgical intervention. The tone of most of these writings is, however, on the whole, rather conservative, and when we consider the really marvelous outcome of many of these curative attempts, undertaken with more or less hesitation by patient and physician alike, it seems surprising that such a general level of moderation should have been maintained. Especially in connection with surgery was the employment of radium urged upon the gynecologist. For example, in 1917, we find Robert T. Frank recommending that operable cases be subjected to a short preliminary treatment by radiation, followed by an abdominal total hysterectomy and salpingo-oöphorectomy without excision of the parametria. He adds this caution, however: "It is not justifiable, in the present state of our knowledge, to rely

solely upon radium treatment in operable cases, unless the patient is an exceptionally poor risk (excessive obesity, severe cardiac, pulmonary, or renal disease), because there is as yet not sufficient evidence that a permanent cure can be produced by radium." He advised preliminary radiation extending over a three weeks' period, during which time he employed three exposures ranging about 2,000, 1,200 and 800 mgm. hours each. A hysterectomy was to be done some two or three days after the last radium exposure, and four weeks later the radium treatment was to be resumed—at least three treatments at four-week intervals.

The technic employed gradually changed and modified in accordance with the experience and theories of individual operators. Bailey and Healy observe that in May, 1921, when they made a "presentation" of their results, it was apparent that there was considerable improvement in the results of the second three-year period—1918 to 1920—which they ascribed to differences in their method of treatment. In the first three years—1915, 1916 and 1917—the treatment was conducted with only a limited amount of radium and its application was localized, as in the Continental procedure. At the end of the year 1915, they discontinued their attempts to cross-fire through the rectum and through the uterus, because recto-vaginal fistulæ so frequently resulted. The cross-firing was replaced during the year 1916 by the method which is still employed at the Memorial Hospital, the "reapplication of the radium to different areas of the cervix." Twelve hundred millicurie hours constituted the first dose, duplicated the following week, with slightly smaller doses for the third and fourth weeks. This always produced a severe slough in the cervix, but was regarded as advantageous in that it concentrated the radium application in the center of the disease. After 1918, cross-firing from the vagina, the neck of the uterus and the external surface of the body was extensively employed. A platinum piece was used in the cervix with another above in the neck of the uterus for a total of about 3,000 mc. hours, and the parametrium was radiated by a gram or more of radium placed in the vault of the vagina in a "bomb container." This container was directed towards each lateral fornix in turn, with a central application against the cervix to reinforce the radiation in the tissues immediately adjoining the cervix. External radiation was accomplished by the use of a block applicator which was successively placed in six different locations around the pelvic girdle, each position being given one-half the erythema dose.

At this hospital—the Memorial in New York—the enthusiasm for radium as the ideal therapeutic agent for cervical cancer has never wavered, but in other quarters the end of the second decade of the present century witnessed a considerable reaction from the favorable views held a few years earlier. Thus, we find Taussig, of St. Louis, addressing the American Gynecological Society in 1920 on the failures in radium treatment of cervical cancer, and urging that "in the future our efforts should be directed, not to the narration of occasional successes, but to the analysis of our still far too frequent failures with this method of treatment," as it is only by some such effort that we can "hope to find measures that will bring our permanent results to a point in advance of those obtained by surgery." Operation he believed to be preferable in all operable cases under thirty-five years of age and in early, clearly operable cases beyond this age. If obesity, lung, heart or kidney lesions were present radium was to be preferred. Radium treatment of cervical cancer should be kept in the hands of the gynecologist rather than turned over to a radiologist, but this gynecologist should by no means undertake radium treatment of any kind unless he had had preliminary training in the use of the element or its emanation, and was in a position to keep constantly in practice and to observe and avoid the errors which occurred with far too great frequency.

This is really only another expression of the same thought which was expressed by Boggs in an earlier quotation—that radium treatment was being undertaken far too lightly, and that many into whose hands these cervical cancer patients were confiding themselves were by no means competent to give them the full benefit of radiotherapy.

Even five years ago many hospitals, and, to an even greater extent, private practitioners, were handicapped in getting the best possible results because of a lack of sufficient radium element. The cost was so very great and the radium itself so relatively inaccessible that many patients went unrelieved who might have been made comfortable during their last days, or even have had their lives indefinitely prolonged, had the present methods of handling radium emanation been then at hand. If, to-day, the timidity and tendency towards severe criticism which we detect in so much of the literature of five years ago seems incomprehensible, we should recall that, even during the lapse of so short a period of time, the whole radium situation has undergone a radical change.

It was stated by Duncan some four years ago that he had begun his work in 1916 with 100 mg. of radium element in the form of salts, gradually increasing this amount until he had at his disposal approximately one gram of radium element and a well equipped emanation laboratory. His results, he found, had improved steadily as he attained greater skill and more generous facilities, and he constantly employed larger dosage with heavier screening, "producing less local tissue destruction and more effective radiation of the entire pelvis." He in no way shared the discouragement regarding the use of radium which was at that time making itself manifest among so many gynecologists and radiotherapists, and stated emphatically that if we did not get a single cure the palliative results alone which we get from radium would be superior to any other that we could obtain. His own work led him to believe that if we can get the excellent results we apparently do in inoperable cases, and in the small number of operable cases which had been treated by radium alone, radium should be given a much wider application than had hitherto been the case—referring especially to the handling of cervical carcinoma, as he regarded this lesion as outside the realm of surgery, and suitable for treatment by radium under any and all conditions.

The enthusiasm of this radiotherapist is to-day finding an echo in many parts of the country, and is shared by practitioners in widely separated fields of medical endeavor. The value of radium therapy in cancer of the uterine cervix can no longer be disputed. The only aspects of the question still in dispute are the best methods by which the radium treatment may be applied, and the results, clinical and histological, which we may expect to obtain. These I shall next undertake to discuss, in view of the experiences reported by those to whom we have come to look as leaders in radiotherapeutic work and in that especial aspect of gynecology which has to do with cancer of the cervix.

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Treatment of moles, warts and epitheliomata.—The author discusses the varieties of moles and which and under what circumstances they may develop into cancerous growths. Moles may be pigmented or non-pigmented (though this class is of lesser frequency), level with the surface of the skin or raised, with or without hairs or a characteristic warty surface. Certain types tend to develop malignancy and the author has this to say in regard to their removal: "In regard to the advisability of removing moles, it would be safer to remove them in every case, because a small percentage of them will in time undergo malignant change. But it is not customary, I think, to urge their removal except for the following reasons: A mole which is growing larger, or one which has become inflamed, or is breaking down or crusting over should be removed without delay; a mole situated on the nose is especially apt to become malignant; a mole which for any reason is subjected to friction or irritation should be removed."

The agencies employed in the removal of moles and the type of growth in which each is indicated, are discussed at some length. Caustics, electrolysis, CO^2 snow, or excision are used, and methods to relieve the pain of operation are described. In rare cases of moles of extensive surface plastic surgery and skin grafting are resorted to. A mole with a pedicle is never malignant, while the pigmented spot resembling a grain of gunpowder embedded in the skin takes on grave possibilities if irritated.

Roentgen treatment of warts is a tedious procedure, but has the advantage of not leaving scars. The author's technic for freezing a wart with ethyl chloride, curetting it away, and touching the base with lunar caustic is described. Plantar warts are discussed in detail as to pathology and methods of treatment. X-ray treatment has distinct points of advantage over the use of carbon dioxide snow or surgical measures. A moderately intensive dose is used, and repeated every four weeks. The removal of flat juvenile warts is accomplished by other agencies than X-ray with moderate success. Caustics are dangerous agents in the removal of senile or seborrhoeic warts, while X-ray has proven safe and easy.

Epitheliomata are classified as basal- and squamous-celled, the appearance and location of the lesion indicating usually to which type it belongs. The former — sometimes called "rodent ulcer"—constitutes the most common type of cancer of the face in old persons. Its growth and appearance are described in detail. Superficial cicatrizing epitheliomata and the morphea type are curable by radiotherapy "except in an occasional long-neglected case in which the periosteum or bone is involved." In the author's experience only one case out of twenty-one treated during a period of three and a half years has failed of good end-results, and there has been but one recurrence, since apparently cured. The method he employs is that introduced by Fordyce in 1906 and used extensively since that year. Squamous-cell epitheliomata, he believes, should be treated surgically, the only cases responding well to X-rays being "the early ones in which the lesion is superficial and in which deep induration is lacking." Nevo-carcinoma or melanotic carcinoma, which he describes as "the most malignant of all forms of cancer," should be treated by free excision, including some of the tissue on either side.

Moles, Warts, and Epitheliomata. Roy Blosser. R. I. Med. Jour., May, 1925, p. 71.

THE LAWS OF DEVELOPMENT OF X-RAY FILMS [1]

By R. B. WILSEY

ALMOST any kind of development will bring out an image from a suitable exposure impressed upon the X-ray film. The resulting radiograph may be of some value, but it may not be the best that can be produced, and may therefore fail to provide some information of value to the roentgenologist which might otherwise have been obtained by more suitable treatment. It is, therefore, of importance to find the conditions of development which will give the best contrast and detail.

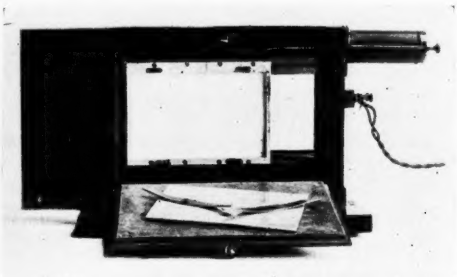

Fig. 1*a*. X-ray sensitometer, or exposing machine, rear view.

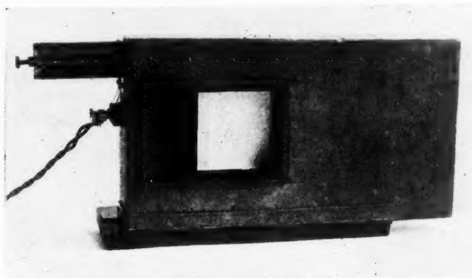

Fig. 1*b*. X-ray sensitometer, front view.

The phenomena of development are known in a general way from practical experience, but in order to obtain more accurate and quantitative information, a systematic study was carried out, using special equipment built for the purpose. Figures 1*a* and 1*b* show photographs of the exposing machine, or sensitometer, of the type designed by Jones (1); it has a rectangular aperture in the lead-covered face for entrance of the X-rays; the film holder is mounted on horizontal guides on which it travels so that successive portions of the film, one centimeter in width at a time, are moved into the aperture and exposed to the X-rays. An electromagnet, acting on a plunger, pulls the film holder over the centimeter distance at the proper times, as governed by an automatic timing mechanism. The X-ray tube current is turned off automatically at the end of the exposure.

The X-ray tube current and voltage are controlled by hand. A storage battery supplies this filament and is provided with suitable rheostats for fine regulation of the current. For regulation of the tube voltage, an auto-transformer is used, permitting variations by steps of one volt on the primary of the X-ray transformer; and finer adjustment is secured by a carbon compression rheostat in series with the auto-transformer.

The films are developed in a hand-rocked tray. To control the temperature of the developer, the tray is built with a water jacket through which water circulates continuously from a thermostat bath held at 65° F. The films exposed in the sensitometer are cut into strips about 2 cm. wide, each having the same series of exposures, and these strips are developed for various times from 1 to 15 minutes. It is thus possible to obtain information on the characteristics of the film over a wide range of exposures and development times. These precautions in exposure and development are necessary where measurements are to be made on the films and accurate and reliable results are desired.

[1] Communication No. 239. From the Research Laboratory of the Eastman Kodak Company. Read before the Radiological Society of North America, at Atlantic City, May, 1925.

Figure 2 shows a set of film strips all having the same series of exposures and developed for various times. The progress of development can easily be observed on these films; density grows continuously with development time; contrast grows for a time, reaches a maximum, and then diminishes owing to the veiling effect of fog on the lower densities. These and other characteristics can be expressed more accurately by graphs. The densities on the films are read with a photometer, and for each development time a curve is plotted of the density against the logarithm of the exposure. A series of such curves for various development times is shown in Figure 3. At each development time, the curve shows how density grows with exposure, at first slowly, and then more rapidly as higher densities are reached.

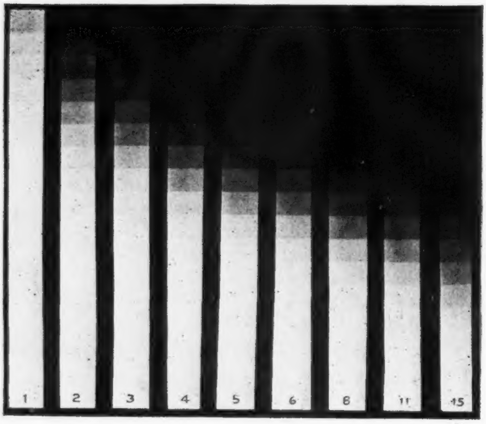

Fig. 2. Set of strips of film, each with the same series of exposures, but developed for different times; the development time in minutes is marked on each film.

The same curves could be obtained by keeping the time of exposure constant and varying the intensity of the X-rays to produce the successive densities. This would correspond with the way a radiograph is made, with a single exposure time, where different portions of the radiograph receive different intensities of X-rays, depending on the various absorptions in the part rayed. However, with the sensitometer it is more convenient to use a constant intensity and vary the exposure time to obtain the various densities on the film.

Each curve in Figure 3 may be considered to represent a radiograph developed for the time indicated. The slope of the curve is a measure of the contrast; since the slope varies continuously along each curve, it is necessary to take the average slope over the density range 0.5 to 2.0, which covers the range of densities useful in radiography.

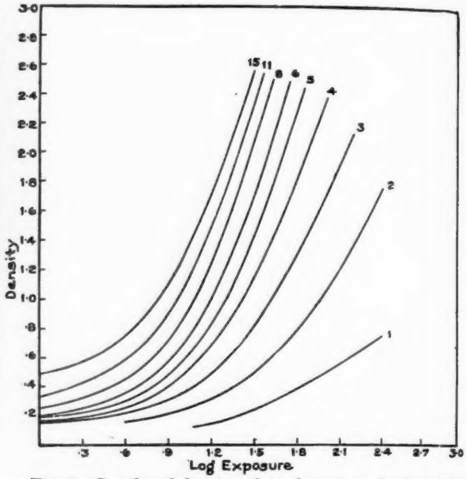

Fig. 3. Graphs of density plotted against the logarithm of the exposure; the number on each curve indicates the development time.

The contrast of each strip of film can then be measured, and the values of contrast plotted against development time. This curve is shown by "A" in Figure 4. It shows that, as development proceeds, contrast increases to a maximum, and then diminishes. This decrease in contrast is due to the growth of fog at the longer development times; otherwise the contrast would continue to increase with development time. The time of development for the maximum contrast is six minutes on this curve. The maximum is rather broad, however, so that a range of development times can be used without altering the contrast appreciably. A safe rule would be to keep the development within a range in which the contrast does not vary more than 10 per cent from the maximum; according

to Curve "A" in Figure 4, this would include any time between 4 and 9 minutes. The exposure must be controlled so that the proper density may be developed within this range of times; any development

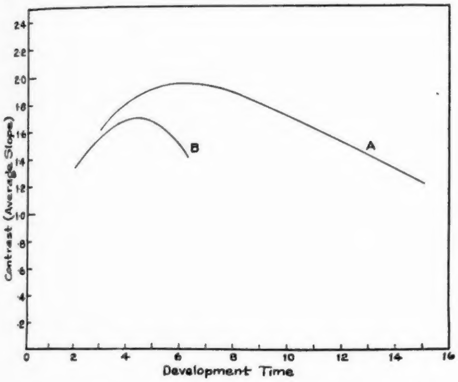

Fig. 4. The variation of contrast with time of development; Curve "A" for normal developer, Curve "B" for developer with insufficient bromide, giving excessive fog and lowering contrast.

outside this range will result in a noticeable loss in quality of the radiograph.

To determine the effect of excessive fog upon progress of development, a series of strips of film was developed in developer having insufficient bromide. The resulting contrast as a function of time of development is shown by Curve "B" in Figure 4. The contrast is less throughout than was obtained with the normal developer; the maximum contrast was reached in 4½ minutes, after which the contrast dropped off quite rapidly. The development range is short, from 3 to 6 minutes; under-exposures could not be developed safely for long times in such a developer. A film giving high fog would behave similarly in normal developer; it would show low contrast; and its contrast would diminish rapidly after the maximum had been reached, so that development could not safely be prolonged. Thus emulsion fog and developer fog must both be kept low to obtain the best contrast and latitude in exposure and development.

Figure 5 shows the growth of fog density with time of development for the two developers. The effect of insufficient bromide upon fog is shown by Curve "B," especially at long times of development.

Since it can not be assumed that conditions will always be favorable as regards

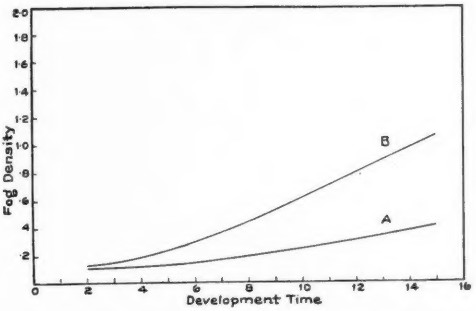

Fig. 5. The growth of fog, with time of development; Curve "A", normal developer, Curve "B", developer with insufficient bromide.

freedom from fog, it is best not to depend too much on being able to develop for times as long as 9 minutes. Taking everything into consideration, it is best to try to control exposures so that the standard time of 5 minutes' development in fresh solution of 65° F. can be adhered to, remembering that in case the exposure is not judged correctly the range of times from 4 to 8 or 9 minutes will usually give negatives of practically equal quality, when developed to the same density.

It is well known that fog affects the lower densities more than the higher densities. Each curve of Figure 2 shows an increase of slope or contrast with increase of density. Therefore, to obtain the best contrast and detail, radiographs should not be too thin; somewhat higher densities are preferable. Density is not too high as long as the radiograph is viewed by sufficiently strong illumination to show the detail in the highest densities which are of diagnostic interest.

Since there is a development range of several minutes during which practically equal contrast of radiograph can be secured, it is of interest to find how the exposure must be varied to obtain the same density of negative at the various develop-

ment times. This is shown by the curves in Figure 6. Thus at 9 minutes' development, about two-fifths as much exposure to X-rays is required as at 4 minutes' development. The curve for intensifying

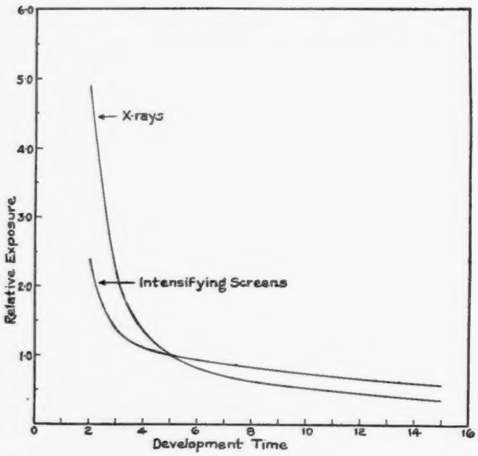

Fig. 6. Relation between exposure and development time to give equal density of negative.

screen exposures differs somewhat from that for X-ray exposures, owing to the rate at which the two types of exposures develop.

In case a radiograph is either over- or under-exposed so that it can not be developed satisfactorily within the proper range of times, then in the next trial the exposure should be halved or doubled accordingly; changes as small as 25 per cent in exposure are of little value in curing over- or under-exposure.

Figure 7 shows a group of radiographs of a small skull; a series of exposures were made from two-fifths normal to five times normal; each film was developed for a time so chosen as to give radiographs practically the same average density. These radiographs illustrate practically the conclusions reached by the instrumental method. There is a range of development times and corresponding exposure times, giving the best radiographs, and beyond this range, the quality is distinctly inferior.

The times of development specified above apply only to fresh solutions of developer. In practice, a developer is used for some time after it has been freshly prepared. Experiments in the exhaustion of X-ray developer have shown that even after considerable use, the solution will give as good quality of radiograph as fresh developer provided the time of development is sufficiently increased. Since the conditions of use and keeping a developer vary so greatly, it is not possible to give any general rule for estimating the degree of exhaustion of a developer. However, a simple test has been found by which the proper time of development for a used developer may be found.

This method makes use of the fact that the time of development bears a definite ratio to the time required for the image to appear after the film is first immersed in the developer. This ratio is known as the Watkins factor. For instance, if the image first appears on the film after 25 seconds' development, and the standard time of development is 5 minutes, or 300 seconds, the Watkins factor is 300/25, or 12. This factor is different for different kinds of developer, but in the development of Duplitized films in Eastman X-ray developer the Watkins factor has been found constant over a wide range of temperatures and degrees of exhaustion. It is necessary only to observe the time of appearance of the image and to multiply this by the appropriate factor to determine the correct time of development. The test can be made once a day, or once or twice a week, depending on the amount of work done.

It is better to make a special test of the time of appearance rather than to try to observe it on some of the radiographs regularly developed in the tank. The development to test the time of appearance is best carried out in a small tray or tumbler, using developer dipped from the tank. The test should be made near the safelight lamp so that the appearance of the image can easily be observed. A dark-room clock indicating seconds is most convenient for observing the time. Small strips of film, about 1 inch by 4 inches,

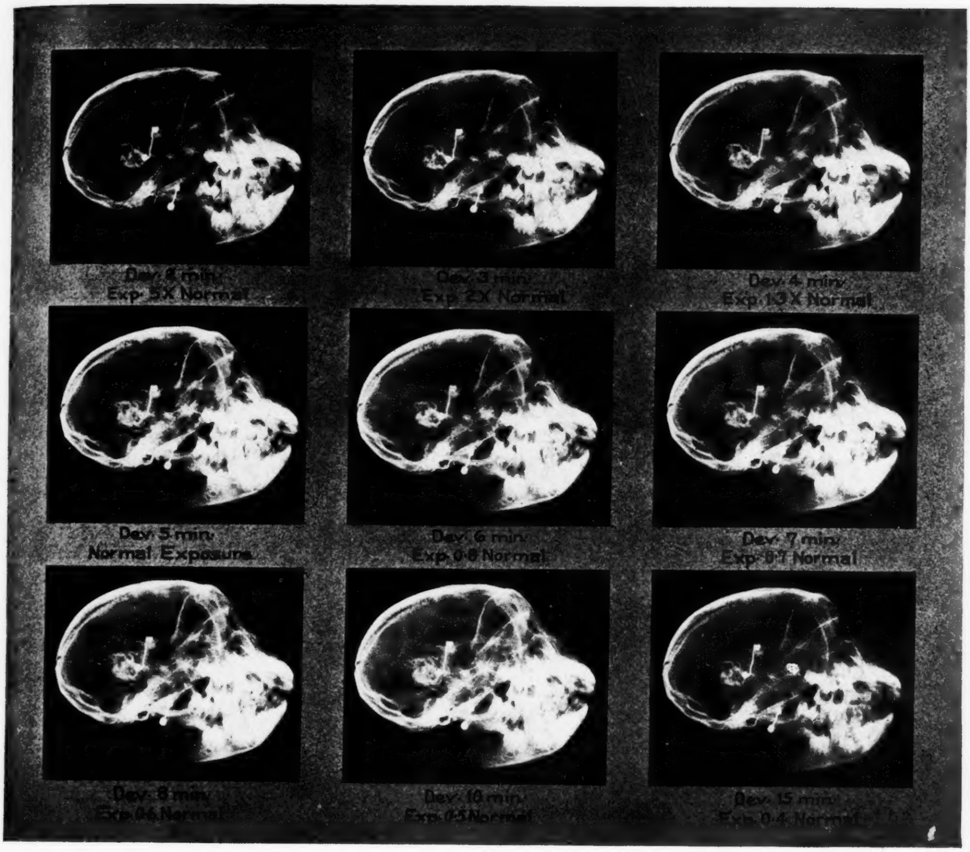

Fig. 7. Radiographs of small skull, exposed for various times, and developed to give equal average density of negative. The best radiographs are given in four to eight minutes' development; development times outside this range give inferior quality regardless of exposure. (Owing to the loss of detail in copying these radiographs by the half-tone process, the effect of too short or too long development is not as apparent as in the originals.)

should be especially exposed for the test, half the film being flashed sufficiently to give a moderately heavy density on standard development, the other half of the film being protected with lead during the exposure.

The diagram of Figure 8 indicates how an 8x10 film may be exposed and cut into strips; two 8x10 films, exposed together in an exposure holder, should supply enough test strips to last during the useful life of the developer. The time of first appearance of the image varies slightly with the exposure, and should be determined when the developer is fresh. The standard time of development, 5 minutes if the temperature is 65° F., is then divided by the observed time of appearance to obtain the Watkins factor. In subsequent tests, the time of appearance is multiplied by this factor to find the correct time of development. In a trial of this method some strips of X-ray film were given an exposure of 15 milliampere seconds at 60 KV., 28 inch target-film distance, without screens. During the exposure, a portion of each strip was protected from the X-rays by a sheet of lead. The time of appearance in fresh developer at 65° F. was found to be 25 seconds. The Watkins factor was $\frac{5 \times 60}{25}$, or 12. This factor could be used

in all later tests of the developer as long as the strips of test film had all been given the same exposure as those used originally. If some other exposure had been used, a different value of the Watkins factor would have been obtained, and this factor would be entirely correct as long as the tests of the used developer were made with films having had the same exposure as the films used originally in deriving the factor. The time of appearance is not noticeably affected by motion or lack of motion of the developer, and no precautions of this sort need be taken in determining time of appearance.

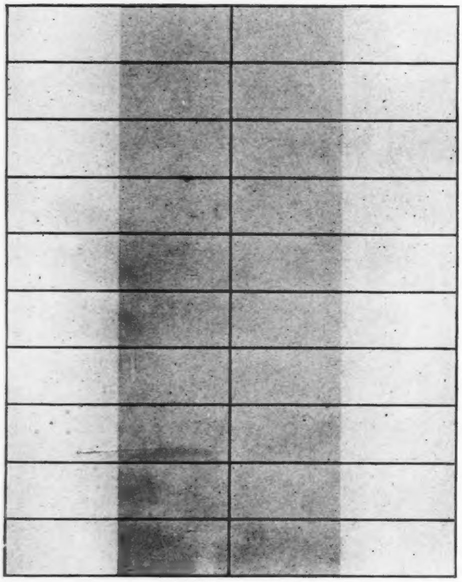

Fig. 8. Diagram showing how an 8x10 film may be flashed over a strip down the center, and cut into 1-inch by 4-inch strips for use in testing exhaustion of developer.

Only a minute or two is necessary to make this test. It would be wise to make the test twice and take the average time of appearance. The use of this test will result in a better and more uniform quality of radiograph and will permit a more uniform exposure technic to be used, whereas, when a fixed time of development is used, the exposures must be increased to get the proper density of negative as the developer becomes exhausted. This method of maintaining a uniform degree of development throughout the life of the developer means, in general, increased development times, since the standard times given by the time-temperature chart are applicable only when the developer is reasonably fresh. This method of testing the developer also indicates when the developer should be renewed; when the standard time of development has increased to eight or ten minutes, economy of time would require that the developer be replaced with fresh solution.

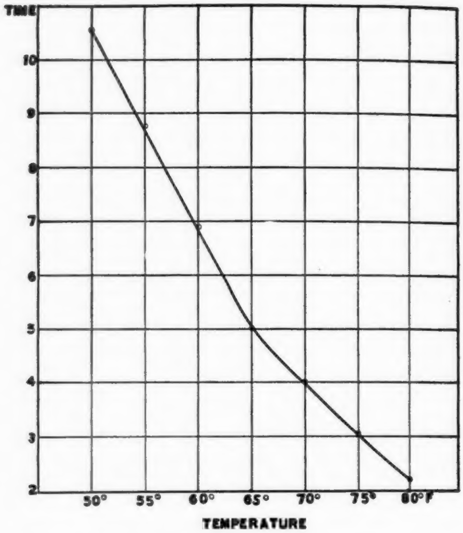

Fig. 9. The variation of development time with temperature of the developer.

Hot weather adds considerably to the difficulties of development. The principal troubles of development at high temperatures are due to the swelling and softening of the gelatine. An effect known as "reticulation" is produced; this consists of a network of fine lines giving a grainy appearance to the film. The softened gelatine is also very susceptible to scratches or pressure. The best remedy is to cool the solutions artificially so that the development and fixing are carried out at the recommended temperature of 65° F. Before washing, the gelatine should be hardened

by immersing the films in a hardening bath or combined hardening and fixing bath so that the gelatine will not soften when the films are transferred to the warm wash water.

If it is not practicable to cool the solutions artificially, it is possible by a special procedure to develop satisfactorily at high temperatures. Methods of doing this have been investigated by Crabtree (2), who recommends the following method for X-ray films:

Excessive swelling and softening of the gelatine are prevented, first, by developing for a short time only, and, second, by the use of a special hardening solution between development and fixing. Thus the gelatine is hardened before it has had time to swell very much, and subsequent operations of fixing and washing can be carried out without danger to the film.

The chart of Figure 9 gives the proper time of development for temperatures as high as 80° F. For temperatures above 80° F., the time of development should be kept at two minutes and the exposures adjusted as nearly as possible to give the proper density of radiograph at this development time. After development, rinse the film for five seconds in water not over 90° F.; then immerse the film in the following hardening solution:

Hardening Solution

Sodium sulphate (crystals) . . .	16 ozs. (av.)
Potassium chrome alum	4 ozs.
Water to	1 gal.

Dissolve in 2 quarts of hot water (about 110° F.) and add cold water to make one gallon. If any scum appears on the surface, remove by skimming.

When first put in the hardening bath, the films should be agitated for 45 seconds, or streaking will occur. Leave the films in the hardening bath for a total time of 3 minutes. Fix the films for twice the time required for opalescence to disappear, and wash for 15 to 30 minutes in running water (not over 100° F.). Wipe both sides of the film with cotton or chamois before drying to remove any possible scum adhering to the surface.

The hardening solution is violet blue in color by artificial light when freshly mixed, but turns green when exhausted and must then be replaced with a fresh bath.

The developing, hardening and fixing solutions should all be kept at the same temperature, or the gelatine will be damaged when the film is transferred from one solution to another at a different temperature. The solutions need not be cooled if their temperature is not higher than 90° F. After fixing, washing may be carried out at temperatures up to 100° F. It may be mentioned here that the hardening solution specified above must be used as a separate solution and not mixed with the fixing bath. Owing to chemical action with the hypo, chrome alum in the fixing bath loses its hardening power after 24 to 48 hours' keeping; this loss occurs whether the bath is used or not. In a separate bath, the chrome alum retains its hardening power for some time, and the color change from violet blue to green shows when the bath must be renewed.

The importance of care and cleanliness in all photographic operations can not be overemphasized. Without proper care in manipulation, the recommendations of this paper would be of little value. It is universally agreed among roentgenologists that the making of a radiograph is a simple matter compared to the skill, training, and experience required for its interpretation; yet there is no reason why the technical requirements for making a good radiograph should be neglected. Since a chain is no stronger than its weakest link, the aim should be to produce radiographs of the highest technical quality, so that the roentgenologist will have the best possible

information on which to exercise his skill in diagnosis.

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DISCUSSION

DR. I. S. TROSTLER (Chicago): I would like to ask Mr. Wilsey a couple of questions. One is, what would be the chemical effect of the addition of magnesium sulphate to the regular Eastman developer? I have done some experimental work in that line, and I have found that I can develop my film at a temperature as high as 100 degrees F. and get pretty good films.

MR. WILSEY: Yes.

DR. TROSTLER: The other question is in regard to the use of desensitizers. I would like to have Mr. Wilsey give us a little on desensitization.

MR. WILSEY: We have used sodium sulphate in the developer at high temperatures to lessen the swelling, and magnesium sulphate would doubtless have the same action. However, its use is not necessary in the procedure just recommended. The hardening solution is very effective, and will harden the film so that it can be developed at almost any temperature that is likely to be met.

As to desensitizers, there are certain dye solutions which are able to desensitize the photographic film. They do not affect the image which has already been produced, but they do decrease the speed very greatly for subsequent exposures. If the film is immersed in such a solution, after exposure and before development, the development can be carried out under a much brighter light than the usual dark-room illumination. A number of dyes have this effect, but practically all of them are open to one objection or another. Many of them stain the film, and some produce bad fog. We have been experimenting on the various desensitizing dyes and the conditions necessary for their satisfactory use, but we are not yet in a position to recommend a dye and the best procedure for its use.

X-RAY TECHNIC: FROM THE OLD TO THE NEW

By E. C. JERMAN, Chicago

X-RAY technic, like X-ray equipment, has passed through an evolutionary stage from the beginning, in 1896, up to the present time, and the end is not yet in sight. Each year in the past has shown some progress and each year in the near future undoubtedly will continue to show progress. The first four or five years the static machine, with an occasional small induction coil, was used to supply the energy to the very inefficient tubes of that period. The static machines were erratic, being exceedingly susceptible to atmospheric conditions, especially humidity. They would work sometimes. It not infrequently required hours of patient endeavor upon the part of the operator to coax the machine into action. Calcium chloride was purchased by the keg for the purpose of subduing the humidity inside the case. In one case, at least, calcium carbide was used. It worked, but it is needless to say that the machine died a violent death; the operator fortunately recovered after the removal of about a pound of glass fragments. There were no meters for measuring the milliamperage and no means of measuring the variable gap in inches or in K.V.P. The time and distance factors could, of course, be measured and duplicated, but the fraction of a milliampere and the gap that might be put into action were purely speculative. During the first two or three years, one hand of the operator usually functioned as a penetrometer. The penetrating value of the X-ray energy from the tube was determined by looking at the shadow of the bones of the hand and wrist with the ordinary non-protected hand fluoroscope. The result of the use of this method by pioneer operators is too well known to need further mention here. There were no intensifying screens or films during the earlier days, and only ordinary photographic plates were available. If the vacuum of the tube did not climb too high or drop too low, if the tube did not puncture, if the patient could be strapped in a stationary position for a long enough time, if the motor man could be kept at his job, and provided extreme care was used in the developing process a fairly decent radiograph of an extremity might be obtained. It is necessary to use the words *might be*, because of the fact that there were several unknown factors creeping in here and there that upset all our plans from time to time. With most operators, little was accomplished with the head or trunk, although thousands of mighty good plates and much time were wasted in the effort. A very few operators were fortunate enough to be provided with large static machines and tubes to correspond and they were able to make some progress with the head and trunk, especially the chest. During this first stage of progress in the X-ray art the technician required the maximum of ingenuity, initiative, and patience in order to accomplish anything at all worth while. Foreign bodies were successfully located occasionally, and some information regarding fractures and dislocations and bone lesions was made available.

The second stage was brought about by the introduction of more substantial tubes and larger and more powerful induction coils. With the induction coil came the milliampere meter, the inch method of measuring the gap, an improvement in X-ray plates and, later, single screens, which were used principally in gastro-intestinal work. The induction coil was not so susceptible to humid conditions but introduced new difficulties in the way of interrupters and chemical rectifiers. A considerable portion of the time of the technician or operator or electrician was required in keeping the interrupter and rectifier in proper working condition. The tubes were about as erratic as ever, the milliampere meter was a real step forward, the inch method of measuring the gap helped some, better plates contributed something

and screens contributed much toward the improvement of gastro-intestinal work. With the static machine the milliamperage was usually less than one, but the gap was sometimes as high as twelve or fifteen inches. With the larger induction coils the milliamperage was usually from five to ten, with a very rare multiple point interrupter that would deliver from fifteen to twenty-five, and a gap ranging by rather large steps up to twelve or fifteen inches.

The tubes were improved step by step, until, by very careful manipulation, the maximum energy of the machines might be used for short exposures. During this stage the technician required a great amount of skill, to be acquired only by long and continuous practice. With this skill well developed an excellent quality of extremity work usually followed and some excellent head and trunk work resulted when the patient was not too large. It still required about all the ingenuity, initiative and patience the technician could command in order to bring about worth-while results.

The third stage was brought about by the introduction of the so-called X-ray transformer, soon followed by tubes with a still heavier carrying capacity, as a much larger amount of X-ray energy was now made available;—as much as a hundred or more milliamperes with a gap ranging upward towards nine or ten inches. The transformer eliminated much of the coil trouble, but the energy was unwieldy and the gap was controllable only by very large steps. The milliamperage was controllable only in part, due to the variable condition of the tube vacuum as well as to the type of control. Considerable improvement in plates and screens was made during this stage, which contributed but little towards lessening the difficulties of the technician.

The fourth stage was brought about by the introduction of the Coolidge tube, quickly followed by the autotransformer control. The single-coated and then the double-coated or duplitized film followed, with double intensifying screens. This stage brought about a great advance in the better control of both the milliamperage and the gap. The Coolidge tube made it possible to duplicate more uniformly a given energy of gap or voltage and milliamperage; tube troubles largely vanished. The autotransformer gave much finer control of the gap or voltage and helped to steady the milliampere factor as well. The double-coated films and screens speeded up the work to such an extent that short exposures could now be made of large individuals. The developments during this stage did more towards simplifying the work of the technician than during all previous stages combined. With the better control of the gap and milliamperage, he could more consistently produce more uniform results. There was still lacking a perfect control of milliamperage, due to varying line voltage and a satisfactory method of measuring the gap or voltage.

The fifth stage was brought about by the introduction of the Potter-Bucky diaphragm. Due to the elimination of a large percentage of the secondary and scattered radiation by means of the diaphragm, a much higher quality of films was made possible and consequently the work of the technician became easier. Double screens were improved during this stage by being made cleanable without the loss of other qualities.

The sixth, or present, stage was brought about by the introduction of the stabilizer and the sphere gap, followed by films of much greater speed. The stabilizer makes it possible to deliver a constant uniform milliamperage from five to one hundred over an indefinite period of time, to duplicate a definite milliamperage from time to time, and to deliver a known higher milliamperage with a smaller focal spot tube. The sphere gap provides a reasonably accurate method of measuring the gap or voltage in terms of kilovolt peaks that may be used with any given milliamperage. By having a machine properly calibrated with a pre-reading volt meter across the auto-

transformer, any available K.V.P. may be immediately delivered at a definite milliamperage without any testing of the tube. The higher speed films make possible still shorter exposures with very large subjects.

With complete modern equipment in good order and the machine properly calibrated and charted, the work of the technician is made much easier. Higher standards may be set from time to time and those standards put into routine production.

Some time ago the writer had the opportunity of visiting a well-known radiologist and was shown some of the finest plates of lateral spines that he had ever seen. Asking the technician what technic he used to produce such plates, he answered, "I cannot tell you how I do it, but I have a patient waiting and I will show you the way I do it." He was using a rheostat-controlled machine with milliampere meter and time switch attached and a gas tube. In answer to the question as to what gap, milliamperage and time he would use, he said, "I pay no attention to any of those things; I never look at the meter, measure the gap, or use the timer." His manner of procedure was as follows: He started the motor and began moving the rheostat lever backward and forward, watching the action of the tube and listening to the sound of the rectifier and tube, and when he felt that he had it set just right he proceeded to quickly place the plate and patient in position. He then dropped his head between his shoulders and closed the X-ray switch, not even counting for time, and when "the hunch" told him he pulled the switch, stopping the exposure. The plate was developed and the result a duplicate of those shown before. He had worked with this equipment so long that he could tune it up as a violinist could tune his instrument, and I was told that he seldom failed. In the old days the technician was forced to develop his skill through long periods of continual practice. The objection to this method of technical procedure to-day is that it is too slow. It requires the expenditure of too much time, effort, and expense. Furthermore, the knowledge and skill that he had acquired in this way could not be imparted to others. With modern equipment and methods it is possible for an intelligent technician to advance farther in a few months than would have been possible in as many years with the older equipment and methods. An abundance of X-ray energy has been available for some years, but it is only recently that this energy has been brought under almost perfect control. If it is desirable to control the end-result, the factors that produce the result must be brought under control. Modern equipment has made possible a more systematic method of technical procedure, that insures a maximum result with the least expenditure of time, effort, and expense.

CASE REPORTS

NICHES OF THE GREATER CURVATURE OF THE STOMACH: REPORTS OF TWO CASES [1]

By CHARLES G. SUTHERLAND, M.B. (Tor.),
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Irregularities of contour of the greater curvature from pressure of a gas-distended colon are comparatively common in the roentgenogram, and less common are defects from the pressure of extragastric neoplasms, or from greatly enlarged spleens. Palpatory manipulation of the barium-filled stomach with the patient turned in various angles will, in almost every instance, reveal the normal contour in the latter, and the mass corresponding to the indentation on the curvature in the former. In the experience of the Mayo Clinic, niches on the greater curvature are extremely rare.

In palpating the stomach while it is filling with barium small flecks of barium may be caught in the folds of the rugæ and for the moment give the suggestion of a niche, but further filling and continued manipulation will straighten out the rugæ and reveal the normal contour. Two cases observed recently in the Mayo Clinic, in which the niche appeared on the greater curvature, were submitted to surgical investigation.

REPORT OF CASES

Case 1. A man, aged forty-one, came to the Clinic complaining of stomach trouble of from five to six years' duration. He had had intermittent attacks of epigastric pain, coming on two hours after meals, relieved by food and soda, and not associated with nausea, vomiting, jaundice or constipation. Temporary relief was obtained for three months by the use of a milk-and-cream diet for three weeks. In the last three months pain had been almost constant, coming on three hours after meals, and only partially relieved by food and soda. The pain in the afternoon was most severe. Five weeks before examination he had one attack of acute pain, starting in the epigastrium and radiating to the left costal region, with a residual soreness in both quadrants of the lower abdomen. There had been no evidence of hemorrhage, and he had not lost weight.

Fig. 1 (Case 1). Niche of a perforated gastric ulcer on the greater curvature. Operation revealed a subacute ulcer, perforated against the sheath of the pancreas.

Roentgenoscopic examination revealed a large niche on the greater curvature of the stomach in the pars media with a converging of the linear markings of the rugæ towards the lesion (Figs. 1 and 2). At operation a subacute, perforating ulcer, 1.5 cm. in diameter and 8 mm. deep, was found on the posterior wall just above the

[1] Submitted for publication June 9, 1925.

greater curvature. The ulcer had perforated against the sheath of the pancreas. A partial gastrectomy (segmental sleeve resection) was performed. The patient recovered uneventfully, and was dismissed

Fig. 2 (Case 1). Roentgenogram made with a small amount of barium in the stomach. Note the linear markings of the rugæ and their convergence towards the site of the lesion in the affected area.

to a convalescent home twelve days after the operation.

Case 2. A woman, aged twenty-eight, came to the Clinic complaining of stomach trouble of six months' duration. She had always had a "weak stomach." During the last six months she had had intermittent attacks of loss of appetite, sour eructations, nausea and belching; these occurred every two or three weeks and lasted a few days. Belching followed immediately the taking of food and lasted an hour or two. Soda afforded slight relief and food none. Four weeks before, the patient had vomited about two ounces of bright red blood and the stool was tarry following this. She had lost weight only slightly. Three weeks before, a mass had been palpated in the upper left quadrant.

Roentgenoscopic examination with but

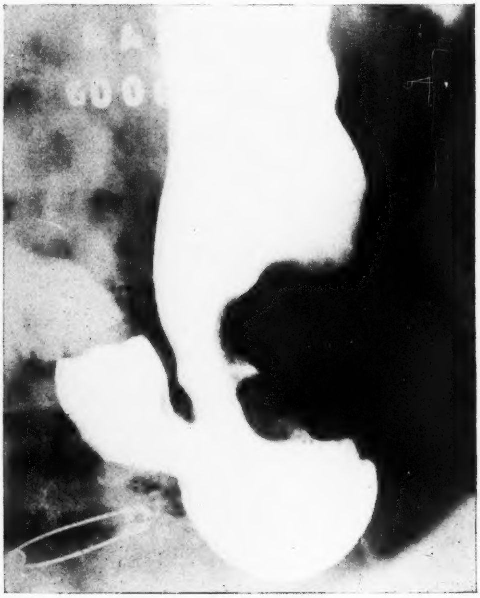

Fig. 3 (Case 2). Large filling defect on the greater curvature of the stomach. Note the irregularity of the margins, the absence of any contour line on the greater curvature border, the broad base and cone-shape of the niche. At operation the two carcinomatous ulcers were found, separated by a deep fissure with a marked diffuse fibrosis of the wall of the stomach adjacent to the growth.

a small amount of barium in the stomach revealed a niche on the greater curvature in the pars media. With the stomach filled with barium a large filling defect became apparent, in the center of which was seen a V-shaped niche. The irregularity of the margins of the filling defect and the absence of any line of contour on the greater curvature suggested a malignant lesion (Fig. 3). Operation revealed two carcinomatous ulcers, each 1 cm. in diameter, connected by a deep fissure, a marked, diffuse fibrosis of the walls of the stomach adjacent to the growth, and rather extensive lymphatic involvement. A nodule excised from the liver with some of the tissue

showed metastatic carcinoma. The growth was operable so far as the stomach was concerned and a palliative median gastric resection was performed with an end-to-end anastomosis. The patient recovered from the operation uneventfully and was referred to her home physician for radiotherapy.

DEPARTMENT OF RADIODONTIA

Under the Supervision of Boyd S. Gardner, D.D.S., Rochester, Minnesota

PREVENTIVE DENTISTRY THAT PREVENTS

BASED ON PERIODIC X-RAY EXAMINATIONS

By HOWARD R. RAPER, D.D.S., F.A.C.D., Albuquerque, N. M.

I

What Can We Prevent?

FIRST of all, what can preventive dentistry prevent? Can it prevent decay of teeth? Most articles written under the title of prevention are written on this assumption.

Those who would prevent decay of teeth may be classified in two groups: the dietitians and the advocates of certain methods of cleaning. The dietitians recommend that in order to actually prevent decay of teeth one should start with the diet of the prospective mother. As for a method of cleaning the teeth which will entirely prevent decay, there is no such method. Cleanliness will lessen the amount of decay; it will prevent some decay; but not all.

The plain fact is that the best dentistry can do for the man, woman or child already born and in possession of teeth is to say: "Eat a good *mixed* diet, and keep your mouth clean. This will tend to lessen decay, but, if you are an average person, it will not prevent it altogether. So watch out."

II

Toothache Preventable

If we cannot prevent decay, what can we prevent?

The answer is toothache. We can prevent toothache, for 90 per cent or more of people. We cannot prevent all decay in 10 per cent.

Imagine a school room of, say, fifty pupils. They are, let us suppose, entirely at our disposal for dental treatment; we can do exactly as we wish with them. In how many, under such favorable circumstances, can we prevent all decay of teeth? In one or two possibly; or, likely as not, not a single one in that particular fifty.

On the other hand, suppose we make our goal the prevention of toothache. For how many could we hope to prevent all toothache? Why, for perhaps all of them, or, at worst, all save one or two!

Prevention of dental decay is something to strive for; prevention of toothache is something to *do*.

And is it worth while to prevent toothache? And how shall we prevent it? And does the prevention of toothache lead to the prevention of other disease?

Before proceeding to the answer of these questions perhaps I should pause to say that, though we make the prevention of toothache our aim, we need not and should not on that account neglect the usual efforts at preventing dental decay. The diet should be an ordinary good mixed diet, as much for the sake of the general health as for the teeth; and the teeth and mouth should be kept clean by the usual brush-

ings, and prophylactic treatment administered by dentists.

Now to answer the above questions. Allow me to lead to the answers gradually by a process of logical development, starting with a very brief philosophical consideration of disease itself.

III

Disease

When a man dies, he does not die all over, all at once, click! just like that! He dies in pieces, so to speak. And when enough of him has died, here and there over

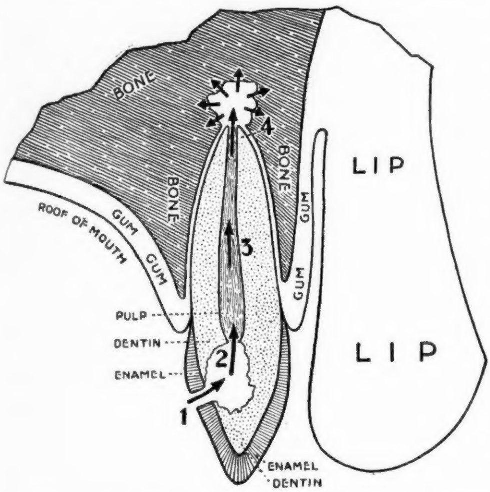

Fig. 1. A drawing of a section cut through the lip, gum, bone and tooth. By cutting through the tooth we see the enamel, dentin and pulp, or so-called "nerve." The arrows indicate the progress of a moving destructive force we call disease. It starts first as dental caries (or "decay"), penetrating the protective armor of enamel and attacking the underlying dentin, Arrow 1; thence through the dentin into the pulp, Arrow 2; on through the pulp, Arrow 3, and through the tooth out into the bone, Arrow 4. And from there to all parts of the body, as suggested diagrammatically by the little burst of six arrows. Toothache first occurs when disease attacks the pulp, Arrow 2. By toothache is meant a *severe* and unmistakable pain, not the slight pains or indefinite annoyances that come and go without apparent cause in and about the teeth. (Courtesy *International Journal of Orthodontia, Oral Surgery and Radiography.*)

his body, the whole organism dies; the man "passes on."

Disease is a death process. The outstanding characteristic of substantially all disease is death and destruction of tissue. Pulmonary tuberculosis destroys the lungs; gastric ulcer attacks the lining of the stomach; cancer attacks most any tissue of the body; wherever there is pus, as in appendicitis and tonsillitis, there is destruction of tissue; nephritis attacks the kidney; and so on. The loss of body weight so common to all diseases is but another manifestation of tissue death and destruction.

The disease dental caries—ordinary decay of teeth—is so common that it is usually not thought of as disease at all, even by many dental and medical men. Yet dental caries is a disease, a disease which attacks the hardest substance in the body, the enamel of the teeth, and destroys it as cancer may attack and destroy the tissues of the nose.

A not unscientific way to look upon disease is to think of it as a tissue-destroying force. This disease, or disease force, which starts with decay of the teeth, if unchecked, soon finds its way into the dental pulp (so-called "nerve") destroying it. It then progresses clear through the tooth out into the bone, destroying it (Fig. 1). From the bone it may spread to almost any tissue or vital organ of the body, manifesting its presence by tissue damage and destruction, causing nephritis, gastric ulcer, rheumatism and other serious and fatal systemic diseases.

The first pangs of toothache occur when disease first reaches and attacks the pulp. (Arrow No. 2, Fig. 1.) Toothache may be looked upon as a warning, an alarm sounded by Nature. To judge by the severity of the pain the occasion for alarm is great; something serious has occurred. Nature is not prone to give false alarms. And indeed something serious has occurred. It is this: disease has reached the circulation, the inside of the body. There is occasion for alarm—and regret.

IV

Treat Disease in Early Stages

Briefly restated the situation is this: The disease which starts with dental decay may

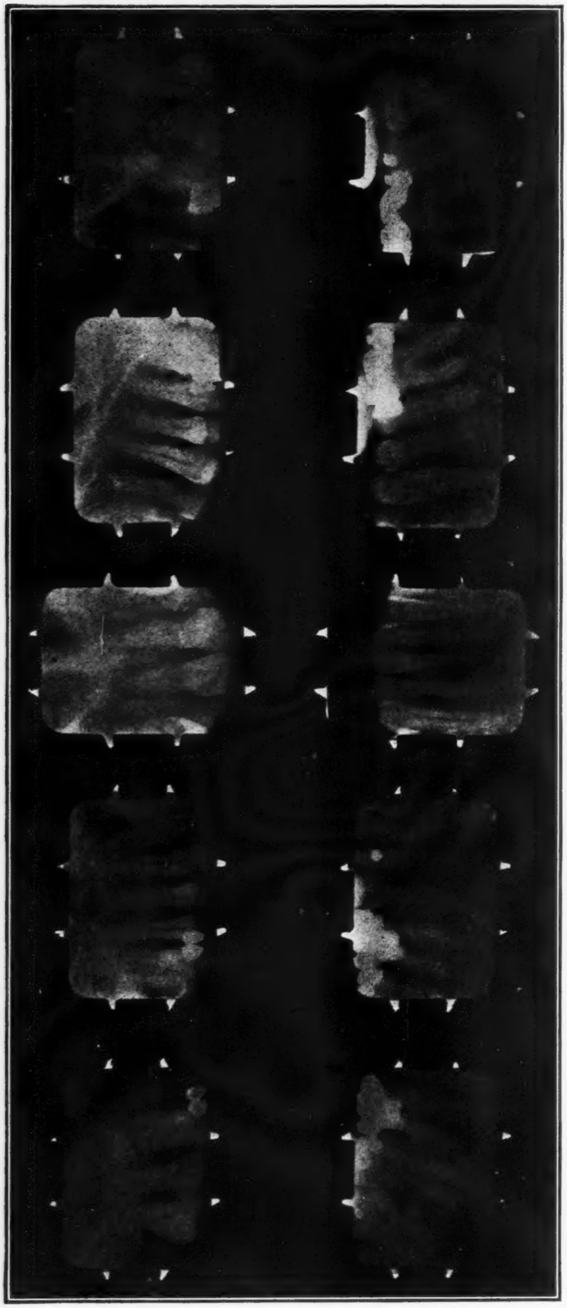

Fig. 2. The ten-film general examination. ("*Radiodontia.*")

I have pointed out that we cannot stop it by preventing decay, because we cannot prevent all, or anywhere near all, decay. Nor can we stop the progress of dental disease with absolute and unquestioned certainty *after* it has reached the dental pulp (Fig. 1, arrow No. 2), *i.e.*, after the disease has reached the stage where toothache ordinarily occurs.

If we cannot treat a disease with sufficiently satisfactory results after it reaches a certain stage in its progress, it is obviously our duty to prevent it altogether or to treat it before it reaches that stage. And if we are unable to prevent it altogether, as in the case of dental caries, all that is left is to treat it in its early stages when it can still be stopped without great cost and with almost invariable certainty of success. Such reasoning has long been applied to tuberculosis and other diseases. Why are we so slow about making the application in dentistry?

V

Ordinary Methods of Finding Cavities Not Adequate

By carefully filling and refilling teeth, before the cavities are allowed to get too large, dental disease can be kept from ever reaching the pulp, and so toothache is prevented, and disease is kept not only out of the pulp, but out of the bone and the vital organs of the body also.

Cavities in teeth must, of course, be found before they can be filled. This at once brings up the question: Are the methods now in common use such as to enable us to find all cavities in teeth? That question may be answered in the affirmative so

wind up in the heart or kidney or other vital organ, if it is allowed to progress. Obviously we should stop it as positively and as soon as we can.

far as the exposed surfaces (facial, lingual and occlusal) are concerned. But how about the hidden surfaces, the surfaces "in between the teeth," *i.e.*, the proximal surfaces?

All dental radiographers of any experience or discernment know that dentists do not find all the cavities between the teeth. I could, by taking sufficient space, prove, in a didactic manner, that it is a physical impossibility to locate all proximal cavities by the ordinary ocular and instrumental methods in common use; that it is the common practice to look for discolored under-enamel and to depend on patients to direct attention to proximal cavities, and that this practice allows cavities to become dangerously large and expose the pulp (cause toothache) before they are found. I could do this, but I believe there is a shorter, more convincing way to prove the point, by reporting a case in which the matter was put to a practical test.

A young lady of about twenty was selected as the patient. An X-ray examination of her mouth and teeth revealed the following proximal findings: One large cavity, two medium size cavities, two very small cavities, one filling failing at the cervical margin, and one filling with a large "overhang" encroaching on the interproximal tissues—in all, seven findings.

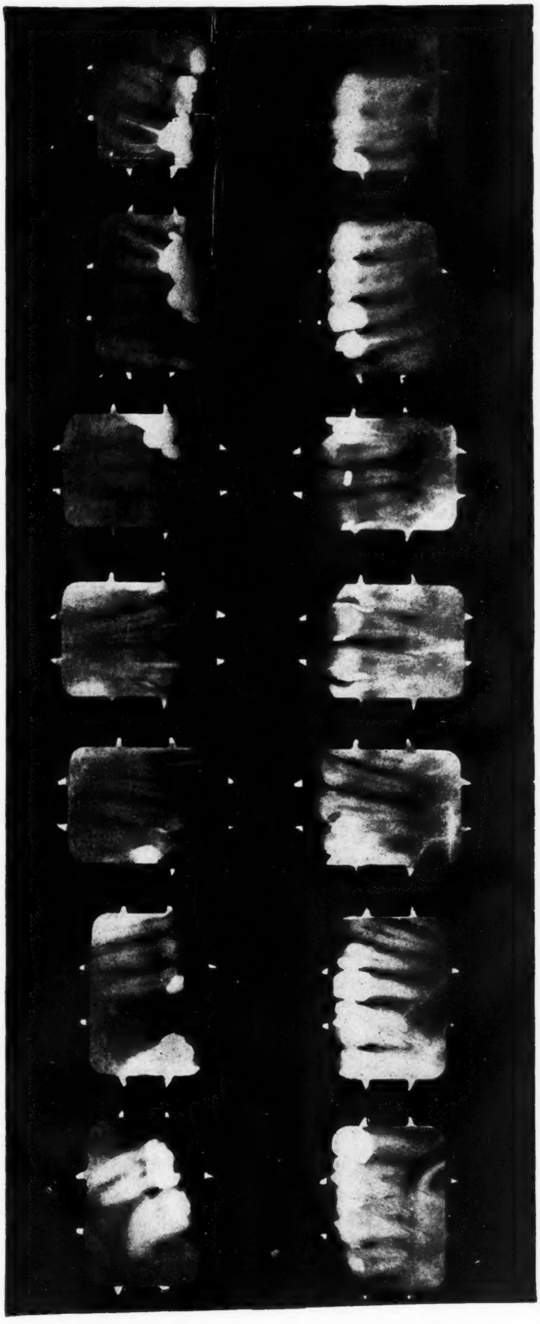

Fig. 3. The fourteen-film general examination. (*International Journal of Orthodontia, Oral Surgery and Radiography.*)

After the X-ray examination, the patient was examined by ten dentists by ordinary ocular and instrumental methods, with the following results: Two dentists found two of the seven findings, six found only one of the seven findings, and two found none of the seven findings! A 100 per cent failure on the part of ten representative dentists to find all, or even a high or moderate

proportion, of the proximal lesions revealed by the X-rays.

Most dentists will admit, in their periods of frankness, that there is usually a good deal of bluff about examining teeth for caries. The time has come to eliminate this bluff. Medicine and dentistry advance by the elimination of pretense. Modern medicine has come a long way from the faith healer who made no physical examination, through the reign of the man who could diagnose any disease by inspection of the tongue and counting the pulse, to the man who to-day depends much on the well-equipped "pathologic" (diagnostic) laboratory.

Allow me to report just one more case: Young lady, aged nineteen. X-ray examination revealed the following: Four large cavities, two very small cavities, four fillings failing badly at the cervical—in all, ten findings. Of the ten findings, eight were in need of immediate attention. (The two small cavities did not need *immediate* filling.)

This young lady was a university student. She was sent to her family dentist with instructions to tell him that she wanted her teeth examined so that she could have all dental work done that might be needed before going away to school for the winter. She was instructed to ask particularly if there were "any cavities in between the teeth" (as was the other young lady whose case was reported above).

Her dentist found only one of the ten findings, eight of which, as I have already said, were in need of immediate attention! Under such care (and the care is in no sense exceptional) that young lady is sure to have exposed pulps, toothache, pulpless (so-called "dead") teeth, and so become exposed to the systemic diseases caused by pulpless teeth.

VI

A New and Less Expensive Kind of X-ray Examination

If it is true, as I contend it is, that dentists fail to find proximal cavities and these cavities can be found by the use of the X-rays, then why are not the X-rays used more for this purpose?

There are two main reasons: (1) Only the dentists who have done a considerable amount of X-ray work realize to what extent one fails to discover the proximal cavities by the ordinary instrumental and ocular methods; others are laboring under the delusion that they are finding these cavities, just as they labored under the delusion that they were treating teeth correctly before the advent of the X-rays in the practice of dentistry. (2) Until recently it has required ten to fourteen or more exposures to make an X-ray examination of the teeth, which is but one way of saying that such examinations were difficult and expensive, costing ordinarily from ten to thirty dollars.

I have developed and have recently announced a new method of examining the mouth with the X-rays for incipient decay (pyorrhea and other cervical lesions) which requires only one-half the usual number of exposures, and so may be done in one-half the time and at one-half the expense. Periodic X-ray examination for the early discovery of proximal decay is, I believe, thus made practical, and so we have a basis for a new and workable clinical preventive dentistry. Given a simplified and cheaper method of examination with the X-rays, I am certain this examination will come into popular use, and when this occurs the great majority of dentists will promptly see how utterly the profession has failed in the past to locate proximal decay in time to insure freedom from danger of pulp exposure, toothache and disease.

The principle on which this new examination rests, is, considering its importance and capacity for the prevention of disease, almost humorously simple: Both the upper and lower teeth (the coronal two-thirds) are radiographed on the same film simultaneously (See Fig. 4). The cost is within the reach of persons of very modest incomes.

A five-film examination can be made for as little as five dollars.[1]

I recommend that the proximal X-ray examination be made yearly or bi-yearly, depending on the case. Up to the age of about thirty, I would say the average person should have the examination made every year, because, ordinarily, the teeth are more susceptible to decay in early life. After thirty, examinations may be made every eighteen or twenty-four months, unless there is some special reason for making them more frequently.

To propose such periodic examinations to patients without suitable explanation would, of course, bring out objections on their part. Goodness knows, expenses are high enough in America; few indeed have any appetite for adding to them. But the fact is that the patient will find it much cheaper to pay for periodic X-ray examinations and so prevent toothache and its sequelæ of trouble and expense, than to cling to the older custom of allowing teeth to ache. It is an easily demonstrable fact that it costs a patient more to neglect one or two teeth until they ache than it costs for a whole lifetime of periodic interproximal X-ray examinations; not to mention the pain and ill-health avoided by preventive measures, or the damage to personal appearance occasioned by the loss of teeth. I have been agreeably surprised to discover how promptly patients understand the advantages of prevention and how readily they take to the plan herein advocated.

I must emphasize the fact that this new interproximal examination is in no sense calculated to take the place of the older familiar periapical X-ray examination. It is made for a different purpose. It is made to prevent pulpless teeth. The periapical X-ray examination is made mainly to observe such conditions after they have been allowed to occur. If a patient needs a periapical examination, this new examination cannot be substituted. On the other hand, a very great number of people need the new examination who do not need the old. Indeed, everybody with teeth, who wants to keep them at the minimum expense and the minimum risk to health, needs the new examination made periodically.

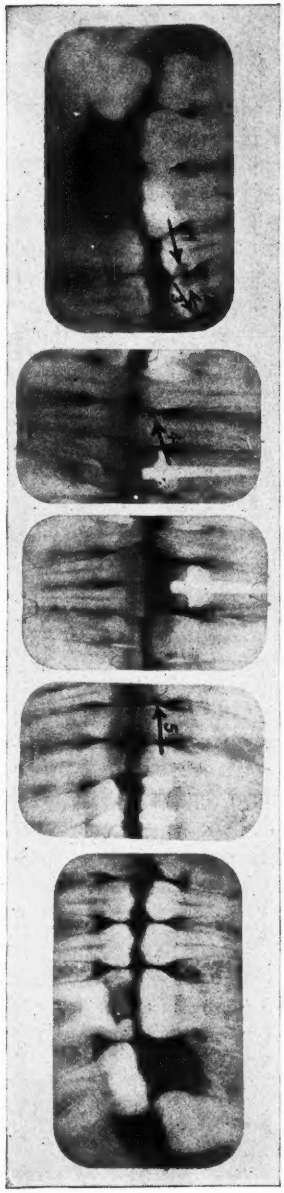

Fig. 4. The new five-film interproximal examination for incipient caries (pyorrhea and other coronal and cervical lesions). Arrows 1 to 5, inclusive, all point to carious cavities. Some are very small (Arrows 3, 4 and 5), while in others the enamel has been completely penetrated and considerable underlying dentin destroyed. (*Note:* Though not difficult to see in original negatives, small cavities are often indistinct or lost—due to loss of detail—in halftone reproductions.) (*International Journal of Orthodontia, Oral Surgery and Radiography.*)

[1]Special size films in a special type packet, provided with a bite-wing, are necessary. Until very recently, the operator has had to make his own bite-wing film packets; but they may now be obtained, already made, from the Eastman Company.

VII

The Faithful Ones

There are literally hundreds of thousands of people in the United States who go to the dentist every six months or year. Why do they go? Do they know exactly why? Do the dentists to whom they go know exactly why? Try asking them and you will discover they do not. The object of these faithful visits is not clearly defined in the minds of either the patients or the dentists. It is time it should be.

Many persons go for no better reason than that they have been told to go so often by the manufacturers of dentifrices. Others would say they go to "have their teeth cleaned," much as they go to have their hair shampooed and their fingernails manicured. Others go to "save their teeth," though they have no clear idea of how this is to be accomplished, knowing only that "it is the thing to do," and the fact that they have heard that "a clean tooth never decays" has something to do with it.

The purpose of preventing toothache—that is, of preventing pulp exposure—must become clear-cut and definite in the minds of both dentists and patients before dentists practise the kind of dentistry that should be practised or patients receive the kind of service they should receive. We must cease to look upon the filling in a tooth as simply a filling, and, instead, view it as a sort of "finger in the dyke," preventing the entrance of disease into the body.

It was away back in 1913 that Dr. Charles Mayo said: "The next great step in medical progress in the line of preventive medicine should be made by the dentists. The question is, *will they do it?*" It can scarcely be said that dentistry has taken the "great step in preventive medicine" mentioned by Dr. Mayo until we have done more to prevent toothache and pulpless teeth. As a lay friend of mine puts it, "The time has arrived to put four-wheel brakes on toothache."

VIII

Teeth and Sickness

One of the most unfortunate things about pulpless teeth is this: they "kick the victim when he's down." Let me explain. A person in good health neglects a tooth or two until they ache severely and then he has them treated and "saved." The bill for the treatment is a little high, he thinks, but the teeth are saved (?) and everything is lovely. But in the course of time this person becomes sick. He is depressed, discouraged, in debt, worried, miserable. And just at this time there is added to his troubles and expense the necessity of examining and considering his pulpless teeth. They are radiographed, and it develops that there is great difference of opinion among different dentists and physicians as to whether they should be extracted or not. In view of the fact that the pulpless ones are the kind of teeth that may cause systemic disease, that their innocence cannot be indisputably established, and that no other possible cause for the illness can be discovered, the physician in charge finally decides on extraction. And so the poor patient must have added to the burden under which he already staggers the necessity of extraction. A radiodontist sees case after case of this sort. Pulpless teeth seem not so bad in the mouths of healthy people, but let these people be overtaken by sickness and those same teeth may become a source of deep concern and worry, considered as possible contributing factors to the ill-health.

Pulpless teeth must be prevented. To save teeth at the expense of health is a ridiculous procedure. Teeth can be and must be saved without even the slightest risk to health. This can be accomplished by the prevention of toothache; that is to say, by the prevention of pulp involvement.

Intrathoracic changes. — Intrathoracic changes are observed wherever a too intensive radiation has been given. The quality of the rays is of no influence. Superficial roentgen-ray therapy produces the same intrathoracic changes as deep roentgen-ray therapy if the necessary dose is projected within the tissues.

The changes produced by the radiation within the chest are of two different types: (A) Early changes manifesting themselves as infiltration; (B) Late changes appearing as fibrosis.

If one single dose less than 100 per cent S.U.D. is administered over part of a lung or over the entire lungs, no changes will occur which can be observed clinically or roentgenologically.

Infiltration of the intrathoracic structures may appear, if a single dose exceeding 100 per cent S.U.D. is delivered to the lungs. If the dose is lower than 140 per cent S.U.D., the infiltration usually clears up; if it exceeds 140 per cent S.U.D., fibrosis develops.

When a dose of 100–140 per cent S.U.D. is repeated over the lungs for the second time within six months, that is, before the infiltration produced by the first exposure has cleared up, the infiltration due to the second exposure may be so extensive that, if the radiation has covered both lung fields, an entire loss of function of the lungs, with exitus, may follow.

Fibrosis of the intrathoracic structures may appear if a dose of 100–140 per cent S.U.D. is repeated over the same parts of the lungs. If the dose is repeated twice, fibrosis will appear in about 80 per cent of cases. If the dose is repeated three or four times, fibrosis will appear in every case.

The prognosis of the radiation infiltration is good; the changes usually clear up without leaving any anatomical or functional disturbance. However, because of the locus minoris resistentiæ created, the patient is susceptible to bronchial or pulmonary infection.

The fibrosis has different prognoses according to the degree of extension. A slight fibrosis causes no inconvenience to the patient and is only accidentally discovered. A fibrosis extending through one entire lung may produce rather severe symptoms; however, the prognosis as to duration of life is not unfavorable.

Statistics of 80 patients treated for mammary carcinoma or tumors within the chest are given. These show that when using adequate technic fibrosis is rather rare. In inoperable cases, where repetition of large doses is necessary, fibrosis cannot be avoided.

J. D. Camp, M.D.

Intrathoracic Changes Induced by Heavy Radiation. William A. Evans and T. Leucutia. Am. Jour. Roentgenol. and Rad. Ther., March, 1925, p. 203.

Gall-bladder examinations. — The author uses 5.5 gms. of the drug dissolved in 40 c.c. of distilled water and injected intravenously in two doses, 20 c.c. at first and then repeated in half an hour. Considerable reaction was noted in many of the cases, some quite severe. No patient having a cardiac lesion should be subjected to this procedure, nor can diabetics or those suffering from severe constitutional diseases be considered as good risks. Highly emotional and neurotic patients do not take kindly to the test, almost always showing grave symptoms. It was found that patients who had been on a starvation diet did not react so severely.

The roentgen examination is made at 4, 8, 12, and 24 hours following the examination. In the author's experience the average normal gall bladder was most distended four to five hours after the administration of the drug. It gradually lessens in size, but becomes more distinct from the seventh to the eighth hour. The shadow then gradually diminishes in size and distinctness, disappearing entirely about thirty hours after the injection.

From a study of 36 cases the author concludes that the normal gall bladder varies in size, shape and position and that it is difficult, in many instances, to recognize what really is deformity and malposition.

When the gall-bladder shadow is not obtained, one of the following conditions is usually indicated: (1) An obstruction of the cyatic duct either by stone, angulation, bands or adhesions or a swollen mucous membrane; (2) The contents of the gall bladder may be such as to fail to readily mix with the dye-impregnated bile, especially thickened mucus or inspissated bile; (3) The walls of the gall bladder may be so thickened and the lumen so contracted that there is not sufficient bile retained to cast a shadow; (4) The gall bladder may be so large or the amount of the contents so great (as in hydrops) that the opaque bile is diluted to such an extent that it does not outline the gall bladder satisfactorily; (5) The liver function may be so poor as to delay or entirely prevent a sufficient amount of the dye-impregnated bile from entering the gall bladder.

The most positive result of this test is the outlining of gallstones of lighter density than the surrounding tissues. These are usually composed of pure cholesterin and cannot be demonstrated by the ordinary films.

J. D. Camp, M.D.

Further Experience with Tetrabromphenolphthalein Sodium Salt in the Roentgenographic Diagnosis of Gall-bladder Disease. William H. Stewart, Am. Jour. Roentgenol. and Rad. Ther., March, 1925, p. 259.

EDITORIAL

THE USE OF FILTERS IN DEEP X-RAY THERAPY

The choice of filter for X-ray therapy is equally important with that of voltage, milliamperage and tube distance. The practicability of a definite technic depends largely upon filter—too much filter increasing the time of treatment too long; too little filter not giving a sufficiently penetrating ray.

A brief discussion of how a filter acts may not be amiss. When a beam of X-rays of various wave lengths impinges upon a metal filter, certain of the waves are absorbed more than others and the composition of the emerging beam is different from that of the impinging beam. We notice a similar phenomenon when sunlight passes through window glass. A large part of the ultra-violet light in the beam is absorbed by the glass, and the emerging beam is poorer in ultra-violet than the impinging beam. It must be clearly understood that a filter in no way lessens the wave length of any part of the X-ray beam—it simply absorbs a greater percentage of the long waves than it does of the short, thereby making the average wave length of the whole beam less. If these long waves were not absorbed by the filter, they would be absorbed by the skin. The advantage of having them out of the way is obvious. It means that we may treat for a longer time and with a more penetrating ray without affecting the skin.

Besides the general absorbing effect which is approximately proportional to the cube of the wave length of the impinging X-ray, there is a selective absorption of the rays which is a function of the metal composing the filter. Thus we may start with a given beam of X-rays and cut the intensity to, say, one-fourth with a copper filter. Now starting with a similar beam and cutting the intensity the same amount by using sufficient aluminum, we find that the composition of the two resultant beams is different, although the quantity—measured ionometrically—is the same. If we analyze these two beams spectroscopically, we find the first relatively richer in short wave lengths than the latter. This is the reason that in deep therapy we prefer copper to aluminum as a filter. This is due to the selective action of the metal itself.

The relation between the absorptive powers of filters is an important point. It is not correct to make a statement such as "one-fourth millimeter of copper is equivalent to one millimeter of aluminum." Due to the selective absorption of the two metals, the above is true only at some one definite voltage. Duane has shown that for a wave length of 0.095 Ångström units, six millimeters of aluminum are equivalent to one millimeter of copper, while for a wave length of 0.34 Ångström units it takes no less than thirty millimeters of aluminum to absorb as much as one millimeter of copper.

Recent tests, which we have made, show that at a 110 P.K.V. (7-inch parallel gap), 1 mm. of copper absorbs five times as much as 5 mm. aluminum, while at 220 P.K.V. ($16\frac{1}{2}$-inch gap), 1 mm. of copper absorbs only two and one-half times as much as 5 mm. aluminum.

This shows that aluminum is a relatively better absorber of short rays than copper, while copper absorbs the long wave lengths better than the short ones. Since it is the long waves which we want removed, copper

obviously serves the purpose better than aluminum.

The question of proper filter thickness is a perplexing one. We use filters to increase the average penetration of the rays and, in general, the thicker the filter, the greater is the increase. However, it is obvious that, due to the general absorption by the filter, there is a point beyond which further increase in the thickness of filter will so greatly increase the time necessary for treatment that it is not economical.

A convenient measure of the hardness of a beam of rays used in therapy is the "depth dose at 10 cm." obtained with the beam. By "depth dose at 10 cm.," we mean that percentage of a beam which has penetrated to a depth of 10 cm. in tissue or in paraffin. Thus if one hundred units of X-ray energy impinge on the skin, and forty-five units reach a depth of 10 cm., the depth dose at 10 cm. is 45 per cent.

With no filter, even at high voltages, the depth dose is very low—only a few per cent. At 200 P.K.V., 50 cm. distance, 2 mm. aluminum filter will give a depth dose at 10 cm. of about 25 to 27 per cent.

¼ mm. copper, about 35 per cent
½ mm. copper, about 40 to 42 per cent
¾ mm. copper, about 44 to 45 per cent.
And 1 mm. copper, about 47 per cent.

We see that increasing the filter helps our depth dose, but let us see at what cost. For every ¼ mm. copper, we must add, roughly, 25 per cent to our treatment time, due to general decrease in intensity of the beam by absorption. In going from ½ mm. copper to 1 mm. copper we have gained 5 to 6 per cent in depth dose at a loss of 50 per cent in X-ray output, which means that instead of a 60-minute treatment, one 90 minutes long would have to be given. Sometimes, in certain cases, the extra few per cent depth dose is of utmost importance for successful treatment and is well worth the extra treatment time necessary. In other cases, where the lesion is near the surface, or where the patient is thin, sufficient X-ray energy is delivered by a beam filtered by ½ mm. copper. In these cases it is unnecessary and uneconomical to filter with heavier than ½ mm. copper.

When X-rays strike a metal, under certain circumstances, characteristic rays are set up by that metal. These rays are much longer than the original exciting rays, and have a definite wave length. The impinging rays, in order to set up this characteristic radiation, must have a wave length shorter than that of the characteristic rays. The heavier the metal, the shorter the characteristic rays. Thus the characteristic rays of tungsten are excited at 90,000 volts. The characteristic ray of copper is excited by 11,000 volts and is so long that it is completely absorbed by not more than one millimeter of aluminum. The characteristic ray of aluminum is, in turn, excited by a still lower voltage, 1,200. The aluminum rays are so long that they are totally absorbed by the air between the tube and the skin. This is the reason for putting an aluminum filter between the patient and a copper filter.

The determination of the most efficient filter to be used may best be accomplished by ionometric measurements. These measurements may be used to determine both the increase in hardness due to the filter and also the time increase necessary in treatment. With an intelligent use of filters, the effectiveness of a beam of X-rays for therapeutic use may be greatly enhanced.

ROBERT S. LANDAUER.

THE LONDON CONGRESS

Those of us who visited the International Congress of Radiology held in London, July 1-4, were immediately impressed with the energy and efficiency of our British colleagues. The complete success of the Congress was largely due to their careful

preparation and to a fine spirit of cordiality and co-operation which prevailed throughout. About 550 radiologists, representing twenty-one countries, attended the meeting, which was, incidentally, the largest international congress of any kind which has been held since the war.

Although the Congress was called as a "preliminary meeting," the delegates voted to consider it the first of a series of permanent international congresses. The officials of the preliminary meeting were approved. The second congress is to be held in Sweden in 1928, with Dr. Gösta Forssell as President.

The banquet was a success from both a gastronomic and a social standpoint. It was dignified without being stiff. We experienced a feeling of pride that our branch of the medical profession should be responsible for this unity of twenty-one nations. One representative of each country spoke at the banquet,—the languages used being English, French and German. The excellent speeches and the sincerity of the speakers convinced one that our future meetings will also be crowned with great success. The fine spirit that prevailed everywhere and at every meeting, the effort of every member to give the best that he had to his colleagues, filled us with a feeling of humility combined with a deep sense of pride in our profession.

From the viewpoint of the radiotherapist, perhaps the most important action of the Congress was to authorize the appointment of an international committee to consider the establishment of an X-ray standard of intensity and an X-ray biological unit. The British X-ray Unit Committee, appointed February 9, 1923, under the chairmanship of Sir William Bragg, has been requested to communicate with the various physical and radiological societies of the world asking for nominations to such an international committee. Another important result of the Congress will probably be an attempt to unify the standards of protective methods in relation to X-rays and radium, as suggested by Dr. G. W. C. Kaye.

In the symposium on the gall bladder, the papers of Dr. Sherwood Moore and Dr. R. D. Carman were especially well received, the latter reporting 1,100 cases examined by cholecystography. From the mass of data presented in this symposium, it seems proper to conclude that either the oral or intravenous administration of the dye is safe and useful and that the oral method will become a routine office procedure, to be confirmed by the intravenous method in doubtful cases.

"The Biological Effect of X-rays," by Dr. E. C. Ernst and Dr. M. T. Burrows; "Non-opaque Foreign Bodies in the Air Passages and Food Passages," by Dr. W. F. Manges; "The Effect of Radium on Mitosis in Tissue Culture," by Dr. R. G. Canti and Dr. F. G. Spear, and "The Effect of X-rays on Mitosis in Tissue Culture," by Dr. T. S. P. Strangeways and Prof. Hopwood, were especially well received. Dr. Robert Knox read a report, "Investigation of the Cardiac Movements by the Use of the Slit Diaphragm and the Moving Film," which described a diagnostic method promising at least as much as the electro-cardiograph. The cinematographic films of Dr. Lewis Gregory Cole, including a new one on ulcer, were viewed with great interest.

Because of the large number of papers read and the fact that the Congress was divided into four sections, it is obviously impossible to make a selection upon which to comment. All the papers, a list of which was printed in the July number of RADIOLOGY, will be published in the *British Journal of Radiology*, and will be a valuable addition to radiological literature. They will probably occupy eight monthly issues, which may be obtained from the British Institute of Radiology, 32 Welbeck St., London, W. 1, upon payment of the special subscription price of 42 shillings.

ARTHUR W. ERSKINE, M.D.

FIRST INTERNATIONAL CONGRESS OF RADIOLOGY

The First International Congress of Radiology will go down in medical history as the greatest achievement of organized radiologists. Not only were there assembled for the first time the greatest number of radiologists—over five hundred—but among them the most distinguished scientists from every civilized country in the world. There were four full days of intensely scientific work in English, French, German, Spanish, and Italian, and to one privileged to attend and understand, the results were invaluable. One could not help being impressed with the masterful manner in which our British colleagues handled the Congress, the size of which exceeded their expectations by several hundred members. As an American, it gives me pleasure to feel that the work of the American contributors measured up in every way with that of our foreign collaborators. The dinners and luncheons tendered by our British hosts were delightful, and well attended.

The outstanding points of the Congress, as viewed by the writer, were:

1. The astonishing grasp of the subject of radiology which was demonstrated by those who spoke before the Congress, namely, H. R. H. the Duke of Connaught and Lord Robert Cecil, the latter one of Britain's greatest statesmen.

2. The spirit of co-operation which existed between the surgeons and the radiologists. This was happily expounded by Sir Berkeley Moynihan, who delivered the McKenzie Davidson lecture.

3. The complete success of the Congress, due largely to the personal sacrifice and work of Dr. C. Thurstan Holland, Dr. A. E. Barclay, Dr. Robert Knox, Sir Humphry Rolleston, Dr. John Muir, Dr. James Metcalfe, Dr. Stanley Melville, Dr. J. E. A. Lynham, and their co-workers.

The election of Dr. Gösta Forssell, of Stockholm, as President, at the conclusion of the Congress, met with unanimous approval, and he was greeted with an ovation which will not be erased from memory.

The Ladies' Committee were especially gracious and kind in providing real entertainment for the visiting ladies.

ALBERT SOILAND, M.D.

At the close of the meeting the following resolutions were adopted unanimously:

FIRST INTERNATIONAL CONGRESS OF RADIOLOGY, JULY, 1925

At meetings of the delegates held at this Congress the following resolutions were passed:

1. That this Congress in London is the First International Congress of Radiology.
2. That Mr. C. Thurstan Holland is elected President; and that at future Congresses the delegates shall elect the President on the nomination of the country holding the meeting.
3. That further International Congresses shall be held at intervals of three years, or at such an interval as the delegates at each Congress shall decide.
4. That the next Congress shall be held in Stockholm in 1928 and that Professor Gösta Forssell shall be the President, on the nomination of the delegates from Sweden.
5. That any country having a radiological society or societies shall be entitled to send not more than five official delegates to each Congress; but only one vote shall be exercised by each country.
6. That the country in which any Congress is held shall be entirely responsible for all the Congress arrangements, financial and otherwise.
7. That Prof. G. Forssell be appointed Chairman, Mr. C. Thurstan Holland, Vice-Chairman, and that Dr. Stanley Melville (the Secretary-General of the London meeting) be appointed the Secretary of the International Delegate Committee until the next meeting of delegates.

8. That a sum of money not exceeding £20 shall be allotted to the Secretary of Delegates from the funds of each Congress meeting to cover his expenses.
9. That these resolutions shall be forwarded to the editors of radiological journals with a request for their publication.

(Signed on behalf of the International Meeting of Delegates.)

July 4, 1925.

ANNUAL MEETING: AMERICAN ROENTGEN RAY SOCIETY

The following is a tentative program for the Twenty-sixth Annual Meeting of the American Roentgen Ray Society to be held at the Mayflower Hotel, Washington, D. C., Sept. 22-25, 1925. All physicians who are interested are cordially invited to attend.

TUESDAY, SEPTEMBER 22, 1925

9 A. M.

Symposium on Gall-bladder Disease

1. Experimental and Physiological Findings in the Study of the Gall Bladder by Cholecystograms. LESTER R. WHITAKER, Boston, Mass.
2. Pathology of Gall-bladder Disease. A. S. WARTHIN, Ann Arbor, Mich.
3. The Secondary Evidence of Gall-bladder Disease. WEBSTER W. BELDEN, New York City.
4. Cholecystography from a Clinical Standpoint. M. C. SOSMAN, Boston, Mass.
5. Further Developments in the Jejunal and Oral Administration of the Tetraiodophenolphthalein Sodium Salt. WILLIAM H. STEWART, New York City.
6. The Development of Cholecystography. EVARTS A. GRAHAM (by invitation), St. Louis, Mo.

TUESDAY, SEPTEMBER 22

2 P. M.

7. A Roentgen Study of 500 Children for Thymic Enlargement. C. WINFIELD PERKINS, New York City.
8. A Method for Estimating the Size of the Thymus. F. O. COE, Washington, D. C.
9. Roentgen Findings in the Thoracic Examination of Children. HENRY W. GROTE, Bloomington, Ill.
10. Demonstration of the Bronchial Tree by Iodized Oil. P. M. HICKEY and A. C. FURSTENBURG, Ann Arbor, Mich.
11. Demonstration of the Bronchial Tree by Intratracheal Injections of Lipiodol. H. W. GRADY (by invitation), Washington, D. C.

WEDNESDAY, SEPTEMBER 23, 1925

9 A. M.

12. Pneumoconiosis. H. K. PANCOAST, Philadelphia, Penna.
13. The Effect of Effort on the Size of the Heart: Observations on Animals and on Marathon Runners. BURGESS GORDON, Boston, Mass.
14. Roentgenological Study of the Pharynx. L. REYNOLDS, Detroit, Mich.
15. The Roentgenological Findings in Gastro-jejunal Ulcer. A. B. MOORE, Rochester, Minn.
16. Diseased Appendix as Cause of Acidosis in Children. A. L. GRAY, Richmond, Va.

WEDNESDAY, SEPTEMBER 23

2 P. M.

17. Pyelitis in Pregnancy. P. F. BUTLER, Boston, Mass.
18. A Simplified Method of Measurement of the Superior Strait. L. F. WHEATLEY and HERBERT THOMS, New Haven, Conn.
19. Broad Ligament Extension in Carcinoma of the Cervix. CHARLES L. MARTIN, Dallas, Texas.

20. Roentgenological Examination of the Head. M. J. KERN, St. Cloud, Minn.
21. The Roentgen Interpretation of Cerebral Abscess; Three Case Reports. E. H. SKINNER, Kansas City, Mo.

WEDNESDAY, SEPTEMBER 23
8 P. M.

22. The Caldwell Lecture: Tissue Reactions to Radiation. JAMES EWING, New York City.

THURSDAY, SEPTEMBER 24
9 A. M.

23. Pathological Fractures—Variety and Nature. L. T. LEWALD, New York City.
24. Roentgenographic Appearance of Calcified Bursæ after the Employment of Radiotherapeutic Measures. FRANK B. GRANGER, Boston, Mass.
25. Osteogenic Sarcoma Arising on the Basis of Paget's Disease. CLARENCE E. BIRD, New Haven, Conn.
26. A Localizing Device and Plate Changer for Mastoid Examinations. GEORGE E. PFAHLER, Philadelphia, Penna.
27. Complete Insulation *versus* Grounding as Protection against High Tension Electric Shocks. W. F. HEMLER, Washington, D. C.

THURSDAY, SEPTEMBER 24
2 P. M.

28. The Effect of Roentgen Rays on the Reproductive Capacity of Male Rats. D. R. HOOKER, Baltimore, Md.
29. Effects of Radiation on Gastric Secretion. JAMES T. CASE and W. N. BOLDYREFF, Battle Creek, Mich.
30. Roentgen-ray Treatment in Exudative Iritis. E. C. SAMUEL, New Orleans, La.
31. Treatment of the Bowen Type of Skin Cancer. H. H. HAZEN, Washington, D. C.

FRIDAY, SEPTEMBER 25
9 A. M.

32. Analysis of Cases and Technic in the Radiation Treatment of Carcinoma of the Breast. GEORGE E. PFAHLER and B. J. WIDMAN, Philadelphia, Penna.
33. Effects of Radiation on Squamous-cell Carcinoma Metastasis in Cervical Lymph Nodes. DOUGLAS QUICK and MAX CUTLER, New York City.
34. More about Fractional X-radiation, with Demonstration of Cases. J. D. MORGAN, Philadelphia, Penna.
35. Preliminary Report of the Use of Corpus Luteum Extract to Prevent Nausea in Radiation Therapy of Uterine Conditions. ROBERT H. LAFFERTY and C. C. PHILLIPS, Charlotte, N. C.

THE "BANKERS' SHARES" SCHEME[1]

Physicians throughout the country have been circularized recently by either one concern operating under different names, or by two or more concerns that use exactly the same advertising matter. The scheme is that of offering for sale "Bankers' Shares" of the Ford Motor Company of Canada, Ltd. The physician is told that, as he is the owner of a motor car, he is "hereby extended the privilege of subscribing for, not to exceed Fifty [or some other specified number] Ford Motor Company of Canada, Ltd., Bankers' Shares at $10 each." The offer, however, is sent indiscriminately to physicians whether they own motor cars or not. The "Special Subscription Privilege" blank is an imposing looking affair with an orange-colored border, a serial number and a date limit. The usual get-rich-quick line of "selling patter" is used, the physician being told that those who invested in Ford of Canada in 1904 have received more than $32,000 for each $100 invested; he is told, further, that if Ford of Canada grows to be as large as Ford of the United States, the "$100 invested in Ford of Canada should then be worth more than $15,000." The officers of Ford Motor Company of Canada, Ltd.,

[1] Reprinted by permission from the *Journal of the American Medical Association,* July 4, 1925, p. 39.

are then named, and the impression is given that this company is behind the sale of these so-called Bankers' Shares. The facts are that the Ford Motor Company of Canada is not even remotely concerned in the offering of these Bankers' Shares, the only outstanding stock being the capital stock of $100 a share par value, which is quoted on the open market and the various exchanges. Those operating the "Bankers' Shares" scheme have, it appears, acquired a block of Ford Motor Company of Canada stock which at the present time is quoted around $490 a share. They have then divided each share up into 100 parts which they call "Bankers' Shares," and offer these to the physicians of the country at $10 a "share." In other words, physicians "are extended the privilege" of paying $1,000 a share for Ford Motor Company of Canada stock when the same stock can be purchased on the open market for less than $500 a share. One of the concerns, or, if it is one concern, one of the names under which it operates, has already been restrained from doing business in New York by an injunction issued some months ago on the grounds that the scheme is one that is calculated to deceive. The rest of the country is still "easy meat." Physicians will do well to throw these "Special Subscription Privilege" blanks into their waste baskets.

SUPREME COURT DECISION

JUDGMENT AFFIRMED FOR "RADIOLOGY"

Filed July 10, 1925

Grace F. Kaercher, Clerk

Albert F. Tyler, et al,

Appellants,

24459 vs.

John R. Bruce, et al,

Respondents.

SYLLABUS

1. The evidence sustains the trial court's finding that the Journal of Radiology, published by the plaintiff publishing company for the defendant society, was the property of the defendant society and not of the plaintiff corporation.

2. The plaintiff publishing company by its arrangement with the defendant society did not have the permanent and irrevocable right to publish the official proceedings of the society, or its journal or official organ.

3. The plaintiff corporation was not entitled to an injunction restraining the defendant society from publishing "Radiology," the name of a journal published by the society after its relations with the plaintiff corporation ceased, nor compelling it to give to the plaintiff for publication in the proceedings of the Society.

Affirmed.

OPINION

This is an action by Albert F. Tyler and the Radiological Publishing Company, Inc., against John R. Bruce, Russell D. Carman and the Radiological Society of North America, Inc., for an injunction restraining the defendants from publishing a journal called "Radiology"; from publishing any journal upon the subject of radiology; from refusing to deliver to the plaintiff company the proceedings of the Radiological Society of North America, Inc.; from asserting or maintaining that the Journal of Radiology is not the authorized journal for the publication of the proceedings of the Radiological Society of North America; and for an accounting. There was judgment for the defendants adjudging that plaintiffs were not entitled to relief. They appealed from the judgment.

1. The plaintiff, Dr. Albert F. Tyler, is the majority stockholder of the plaintiff corporation and a member of the defendant society. The defendant Bruce publishes "Radiology" in St. Paul for the defendant society; and the defendant Dr. Russell D. Carman is its president. There is published in Omaha, under the name of the plaintiff corporation, the "Journal of Radiology."

On October 26, 1917, "The Western Roentgen Society, Inc.," was incorporated under the laws of Illinois. Its object, as expressed in its articles, was:

> "The object for which it is formed is the study and promotion of the science of Roentgenology."

Afterwards, in December, 1920, the name was changed, by amendment, to "Radiological Society of North America, Inc.," and its objects were stated to be:

> "Sec. 1. The study and practical application of radiology, radium, electricity and other branches of physics which are associated directly or indirectly with the medical science.
>
> Sec. 2. To provide meetings for the reading, discussion and dissemination of radiological data.

Sec. 3. To maintain the Journal of Radiology.

Sec. 4. To secure and maintain library and museum facilities."

In 1918 and 1919 the Society published "The Journal of Roentgenology." In December, 1919, the name was changed to "The Journal of Radiology." Section 3, quoted above, apparently was adopted after the change of name. Later the constitution was so amended as to make it one object of the Society "to maintain a journal."

At the meeting of the Society at Chicago in December, 1920, when Dr. Tyler was president, the method of continuing the publication of the journal had serious consideration. There were financial difficulties in maintaining it; or at least in getting it established on a self-sustaining basis. The view was expressed that it was necessary to provide a fund for caring for the immediate publication of the journal until it should become self-sustaining. One Plum, who was of experience in publishing, strongly advised the formation of a corporation. It was contemplated that he would be the business manager. Later he and Dr. Tyler did not agree on the terms of employment and his services were not engaged. He expressed the view that if the journal could be made to pay its own way the first year "in years to follow it will be a big money maker." Dr. Tyler was active, and favored the organization of the corporation, and it was decided to proceed with the plan advocated by Plum. It was intended that members of the Society would subscribe for the stock, and some of them did. The Society was not to be a stockholder. If the venture was money-making, the stockholders would have the profit; if a failure, they would lose. In January, 1921, Dr. Tyler organized, under the laws of Nebraska, with its place of business at Omaha, the plaintiff Radiological Publishing Company. The nature and purpose of the corporation as stated in its articles of incorporation were as follows:

"The general nature and purpose of this corporation shall be to print and publish journals, magazines, articles and papers, and, if thought best, to secure advertising and subscriptions therefor; to do a general job printing business, and all other things incidental to the business above enumerated, including buying and selling notes and mortgages, leasing, letting, subletting, buying, mortgaging, conveying and selling such real and personal estate as shall be necessary to carry on the same, and especially to publish 'The Journal of Radiology,' including the solicitation of advertising matter and the obtaining of subscriptions for said Journal."

The method of exercising its powers, as fixed by the articles, was as follows:

"The corporate powers of this corporation shall be vested in a Board of Directors consisting of six members who shall be elected by the stockholders at their annual meeting."

An amendment to the constitution of the defendant society, adopted at the December, 1921, meeting, provided:

"Sec. 1. The society authorizes the formation of a company to be known as the Radiological Publishing Company, incorporated.

Sec. 2. The company and its stock shall be owned and controlled entirely by members of the Society.

Sec. 3. The company shall take charge of the proceedings of the society except as hereinafter provided."

The two corporations, the Illinois corporation and the Nebraska corporation, were separate entities, capable of contracting with others and with each other. The former did not create the latter. Their powers and purposes were distinct.

Things did not go well. The members of the Society did not subscribe freely, and there was a lack of working capital. The annual dues of members were \$10 each, of which \$5 was for a subscription to the Journal. They were not enough, with the money coming from the stock sold, to meet the need. Factional differences arose. After 1922 the Society did not pay the subscriptions to the publishing company.

In December, 1922, at a directors' meeting of the publishing company at Omaha, a resolution was passed to the effect that the publishing company should no longer publish the journal of the Society. The court finds that in passing the resolution the directors acted in good faith after investigation of the financial condition of the company. On the same day the stockholders of the publishing company, at a meeting, whether regularly or irregularly called we do not inquire, made Dr. Tyler general manager, and the publication of the Journal of Radiology was continued in the name of the company.

The Radiological Society at its meeting in San Francisco in June, 1923, changed the name of its journal to "Radiology." The defendant Bruce was chosen business manager and the

publication of "Radiology" at St. Paul commenced, and has continued since.

The trial court found:

> "That the Journal of Radiology is, and always has been, the property of said defendant society and never at any time became the property of the Radiological Publishing Company. That said defendant society never intended to give up, turn over or lose the ownership and control of said journal.
>
> That said journal has never been in any form or manner turned over or given to said publishing company, other than for the purpose of publishing said journal for said defendant society."

This finding is sustained. The journal represented the labors of the Radiological society. The understanding at the 1920 meeting clearly was that it was to be its property; and that the corporation to be organized was to publish it as the official organ of the Society. The journal was the journal of the Society, its official medium of communication among its members, and an essential instrumentality in the promotion of the objects of its incorporation. The publishing company was the agency for putting it in form, attending to its business management, and promoting its circulation. It was a business corporation for pecuniary profit. It hoped to gain through the prosperity of the journal; and its articles authorized a number of other money-making activities. The new journal, "Radiology," took the place of the Journal of Radiology as the official organ of the Society. The Society had the right to have it so. About these matters there is no substantial question.

2. The position of the plaintiffs is that the Society at its 1920 meeting gave a permanent and irrevocable right to the corporation thereafter to be organized, and the organization of which it recognized in the amendment to the constitution made at the December, 1921, meeting, to publish its journal, and its official proceedings, and that this right was not revocable. Their position cannot be better stated than it is put in their brief:

> "The right given the company to publish the journal, including therein the proceedings of the Society, was and is permanent and is not revocable on the part of the Society.
>
> Had the Society desired to resume the publication of the Journal, or publish an independent Journal at some future time, the Society should have so provided when it induced its members to form the company, put their money into it and take over the publication of the journal. It made no such reservation as to time. The Society was making a permanent arrangement whereby the company should publish the journal at no hazard to the Society and at the sole cost of the company."

With this view we do not agree. The Society contemplated that a corporation would be formed, and article 6 of its constitution adopted by way of amendment in December, 1921, recognized the plaintiff corporation as the one. The case is not at all like Western Union Tel. Co. vs. Pennsylvania Co., 129 F. 849, cited by plaintiffs, nor controlled by other similar cases cited. The arrangement was more like a contract for services or employment. See Collier v. Kindy, 146 Minn. 279. Necessarily, the Society, if it fulfilled the objects of its organization, must control the policy of its journal, the character of the material going into it, and this was intended. There was no written contract. No time limit was fixed. *The publishing company did not agree to publish during the life of the Society nor did the latter agree that it might. The Society had the right to revoke at will, or at least within a reasonable time.*

3. The view of the plaintiffs as to their remedy is concisely stated in their brief. They say, "That the *main* purpose of this action is to enjoin the respondents from publishing 'Radiology,' or any other journal *as its official organ.*"

And again they say:

> "It will be borne steadily in mind, that the main relief sought in this action is to enjoin the Society from publishing 'Radiology' or any magazine as its official organ; that the further relief sought of requiring the Society to deliver to the company its proceedings for publication in the Journal, is not necessarily embraced within the main relief sought by this action. It is, however, proper, material and complete relief in order that the company may publish the official journal of the Society in the future. The Society should not have it within its power to hinder or embarrass the company in the publication of the Journal by withholding from the company its proceedings. This is the right of the company."

The trial court finds on sufficient evidence that the publishing company in December, 1922, was in financial straits; that its condition was under investigation by the directors; and that as a result the board resolved not to publish the journal longer. *It finds that the board of directors in doing this acted in good*

faith and that there was no fraud on the part of the Society influencing such result. In view of this resolution of the board and the finding of the court it is difficult to understand how the plaintiffs can have injunctive relief. The case of Small v. Minneapolis, etc., Co., 45 Minn. 264, hardly sustains its view that the act of the board was void. It was not assailed directly by a dissenting stockholder; but the majority interest, and Dr. Tyler was in control, assumed to make him general manager, disregarding the provision of the articles vesting control in the board of directors.

But all this aside, the plaintiff should not have injunctive relief, either negative or mandatory in form. The object of restraining the publication of "Radiology," or other official organ of the Society, is that the Society be without an official medium of communication with its members and others, unless it chooses to adopt as such the journal published by the plaintiff; and if it is required by a mandatory injunction to deliver its proceedings to the plaintiff for publication, the plaintiff is as near as it may be without official recognition the organ of the society, and in appearance substantially is such. *The Society has the right to maintain an official organ responsive to its purposes and subject to its control. The plaintiff does not own the right to publish it, nor can it insist rightfully that the Society shall not publish as it chooses.* If the Society does a legal wrong it is liable. See Alworth v. Spencer, 42 Minn. 526.

Putting the claim that the Society should furnish its proceedings for publication most favorably to the plaintiffs, the action is one in the nature of specific performance of a personal contract to be enforced by a mandatory injunction. That a court of equity has the power in a proper instance to issue an injunction for such purpose is not denied. One was granted in Bennett v. Fox Film Corporation, 149 Minn. 88, where the contract was definite as to time, contained a provision against cancellation, and bound the defendant simply to furnish films to the plaintiff, the operator of a motion picture show. But there the court said that an "injunction to restrain a threatened breach of a contract will not be readily resorted to, but it may be resorted to when necessary to prevent irreparable injury. * * * The matter rests in large measure in the discretion of the trial court. * * * When an injunction necessarily requires the doing of affirmative acts in performing the contract, the relief will be sparingly granted, but the court has power to prevent irreparable injury by issuing mandatory injunctions in such cases." The principle is well enough understood. Only its application involves difficulty. It is not applicable to a case like this. We are not cited a parallel case, but the following cases, whether they hold one way or the other, state the general principle: Iron Age Pub. Co. v. Western Union Tel. Co., 83 Ala. 498; Roquemore v. Mitchell Bros., 167 Ala. 476; Newman v. French, 138 Ia. 482; Fowler Utilities Co. v. Gray, 168 Ind. 1; Western Union Tel. Co. v. Pennsylvania Co., 129 F. 849; Lasky v. Celebrated Players Film Co., 214 F. 861.

Briefs of 300 pages are presented. They have been considered carefully. They discuss thoroughly and well many questions which we do not stop to mention. *In our view, for fundamental reasons, the plaintiffs are not entitled to injunctive relief.* Failing in that, the action should not be retained for an accounting. If the Society owes the plaintiffs they may go to a court of law.

Judgment affirmed.

Plans are rapidly maturing for the annual meeting of the Medical Society of the Missouri Valley, in St. Joseph, Missouri, September 30 to October 2, 1925. The St. Joseph Clinical Society will hold a two-day session at the various hospitals preceding the meeting. A most interesting and instructive program is planned, among others being the following named papers: "The Periodic Medical Meeting," by Dr. E. H. Skinner, of Kansas City; "X-ray Interpretations," by Dr. A. R. Metz, of Chicago; "Conservative Treatment of Fractures of Long Bones in Children," by Dr. Thomas Orr, of Kansas City; "Fracture of the Carpal Bones," by Dr. P. A. Bendixen, of Davenport, and "General Discussion of the Fracture Problem," by Dr. D. Z. Dunett, of Baltimore, Maryland.

A complete program may be obtained by addressing the Secretary, Dr. Charles Wood Fassett, 115 East 31st Street, Kansas City, Missouri.

ABSTRACTS OF CURRENT LITERATURE

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The ceco-colic sphincter tract.—Hirsch, in his paper, has made a noteworthy contribution to knowledge of the anatomy and pathology of the intestinal tract. He describes the proximal portion of the colon which is under description as bearing the same relation to the remainder of the large intestine as the stomach bears to the small intestine, pointing out that many anatomical characteristics, both in lower animals and in man, indicate that its function is to hold the intestinal contents in the cecum so long as is necessary for complete digestion. It is characteristic of mammalia that there is a sac or diverticulum of variable shape at the junction of mid- and hind-gut, whereas in cold-blooded animals (fishes), in which metabolism is slow, there is a very simple digestive apparatus without either large intestine or cecum. In amphibia there is no cecum, though there is some approach to a mid- and end-gut, and the latter has a lumen of greater diameter. Illustrations are given of the region under discussion in *Iguana tuberculata*, in an ostrich, in *Lagomys pusillus* and the apes, and in a series of white rats killed ½, 1, 2, 3, 6, and 47 hours after taking food. Diagrams of the four functional conditions of the ileocolic region of the rat, and the comparative anatomy of the part in the rat, graminivorous bird, horse, and man indicate the essential identity of the part, so far as function is concerned, in all these animals. Hirsch says that in the dead body one meets with cases, particularly if the viscera have been hardened and especially in children, in which between the gas-filled cecum and the ascending colon there is a part of the cecum 25–26 cm. above the ileocolic opening, and this is empty, contracted, and possesses a smaller lumen than the cecum which lies beneath it, or the colon which lies above. Its wall is thicker, musculature stronger, and its color differs from that of neighboring portions of gut; in length it varies between 3 and 6 cm. Turning to pathology of the part, Hirsch points out that constricting bands, pericolitis, simple or tuberculous ulceration, fibrous stricture, and carcinoma occurring in the neighborhood of the ascending colon have their situation in the ceco-colic tract. Illustrations of actual condition and radiographs after administration of contrast meals or injections demonstrate clearly the points that the author wishes to bring out, and he concludes that the constricted or dilated condition of the tract is brought about by chemical means, as in

the analogous case of the pylorus. Local spasm is associated with dilatation of the gut behind the tract, and this is well seen in some of the radiographs. The paper will well repay perusal.

W. S. LAZARUS-BARLOW.

Der Zoko-kolische Sphinktertrakt (The Ceco-colic Sphincter Tract). I. S. Hirsch. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1924, 32, 605-627. (Reprinted from the Edinburgh Medical Journal.)

Pyelonephritis. — Non-tuberculous pyelonephritis in an otherwise normal kidney tends to get well. Recurring attacks should always be investigated by pyelograms. Recurring attacks in kidneys otherwise normal point to some focal infection. Pain is not a constant or reliable symptom; a kidney may become entirely destroyed without localized pain. The urinary sediment should be watched a long time after subsidence of symptoms.

In looking for foci of infection, it is a mistake to exclude the teeth because apical abscesses are not demonstrated by X-ray (Bumpus and Meisser). Devitalized teeth should be removed. Symptoms of stone passing down ureter may be produced by a plug of mucus; with the ureter temporarily blocked, the urine may be clear as it comes from the normal kidney.

In chronic pyelonephritis the diagnosis can be made only by careful examination of catheter specimen of urine and by pyelograms and ureterograms.

W. W. WATKINS, M.D.

Pyelonephritis. Arthur H. Crosbie. Boston Med. and Surg. Jour., May 7, 1925, p. 893.

Heredity and cancer. — 1. Adenomatosis of the large bowel is a condition which tends to develop in succeeding generations in the same family.

2. Individuals with multiple adenomata of the large bowel almost invariably develop cancer in one or more adenomata, after a few years.

3. The members of families with an hereditary tendency to multiple adenomata tend to die of cancer of the large bowel, at an early age.

4. Simple adenomata of the large bowel are common antecedents of cancer.

SOLOMON FINEMAN, M.D.

Cancer and Heredity. P. Lockhart-Mummery. Lancet, Feb. 28, 1925, p. 427.

Liver function test. — In 1920, Widal, Abrami, and Ivanesco described a new test for liver function under the title "digestive hemoclasis." From experiments on dogs they claim to have proved that during protein digestion the peptones absorbed from the intestine are arrested by the liver "proteopexic function" and do not reach the general circulation. In the normal dog the protein meal excites a digestion leukocytosis. On the other hand, intravenous injection of peptone into the systemic circulation in a fasting dog immediately provokes a "hemoclasic crisis": namely, (*a*) leukopenia with a relative lymphocytosis; (*b*) fall of blood pressure; (*c*) hypercoagulability; (*d*) decrease of the refractometric index of the serum. These data were then applied as a clinical diagnostic test for hepatic insufficiency in man, on the theory that in liver disease the proteopexic function is destroyed or impaired and allows a hemoclasic crisis to develop after a protein meal.

The writer does not agree with the conclusions of Widal and his co-workers. His own conclusions are that:

(1) Widal's hemoclasic test for liver function lacks a theoretical basis, and in practice is of no value in the diagnosis of hepatic insufficiency.

(2) During physiologic rest the number of leukocytes in the peripheral blood is subject to considerable and rapid fluctuations, though there are phases in which a state of equilibrium exists.

(3) There is no evidence that the ingestion of milk, casein, butterfat and distilled water in certain quantities, or the local application of cold, influences the leukocytic content of the peripheral capillary blood, the oscillations following these stimuli being the same as the physiological variations during rest.

(4) The phenomena of "digestion leukocytosis" and "digestion leukopenia," described in connection with the hemoclasic test, are simply physiological variations and not the response to ingestion of foodstuffs.

(5) The conflicting conclusions as to the value of the hemoclasic test arise from a failure to recognize that normally the leukocytic count is in a state of flux, and consequently that a single count made before the test does not represent a state of equilibrium.

SOLOMON FINEMAN, M.D.

A Study of the Hemoclasic Crisis Test for Liver Function. A. F. Bernard Shaw. Brit. Med. Jour., May 16, 1925, p. 914.

Vegetal bronchitis. — The chief etiological factor in vegetal bronchitis is the aspiration into the lower air passages of peanut kernels, nut kernels, beans, watermelon seeds, maize, apple, orange or other fruit seeds or pulp; any other inspired vegetal substance may cause it. A history of choking or gagging while eating, followed by wheezing or cough is diagnostic of

a foreign body having entered the tracheobronchial tree.

Diagnosis is by roentgen-ray evidence of obstructive emphysema or obstructive atelectasis, followed by drowned lung; physical signs of bronchial obstruction; wheezing or the audible slap heard at the open mouth; history of choking or gagging.

In discussion, Dr. Willis F. Manges (Philadelphia) stated that the sign of obstructive emphysema was discovered by Dr. Iglauer in 1911, but not published. It is as positive a diagnosis from the X-ray standpoint as if the foreign body were actually casting a shadow. The mechanics are constant. If the obstruction is complete on inspiration there is atelectasis; if the obstruction is to expiration there is emphysema of the particular bronchial distribution. If it is in a small branch, only a small portion of the lung is involved; if in a main bronchus, the whole lung is involved. Every conceivable combination of atelectasis and emphysema have been encountered.

W. W. Watkins, M.D.

Arachidic and Other Forms of Vegetal Bronchitis. Chevalier Jackson, Gabriel Tucker and Louis H. Clerf. Atlantic Med. Jour., May, 1925, p. 506.

Inflammatory conditions.—The author prefaces his paper by the statement that he "wishes to state emphatically that he is not preaching any 100 per cent sure method for the relief of inflammatory conditions." Under the headings, "Felons and Paronychias," "Boils and Carbuncles," and "Neuralgias," he says that radiation has proved a useful aid to surgery, and that chronic and acute conditions, especially the early stages of the latter when severe reactions have not yet manifested themselves, nearly always respond favorably.

Both the American and the foreign literatures contain numerous reports of roentgen therapy for inflammation, the foreign literature particularly making frequent mention of its great value. There are several theories as to the exact method by which the X-rays act: (1) that they effect some peculiar dissolution of excess white cells; (2) that they produce a local hyperemia and are effective through an increase and improvement of local circulation, and (3) that they possess, in a considerable proportion of cases, a positive, intrinsic, analgesic effect.

In felons and paronychias early radiation often aborts the process. If seen later, when there is swelling, lymphangitis, and enlarged regional glands, radiation is almost sure to give relief from pain and abatement of symptoms within twenty-four hours. The doses employed are very small fractional units and are given weekly, the initial dose to be followed by a second or third, if necessary. In cases where the felon or paronychia is too far developed to be aborted by roentgen treatment, the healing may be quickened and the resulting scar kept slight.

The healing of boils and carbuncles may be hastened by roentgen treatment, preceded by a stab incision, where pus is present. "Incompletely developed abscesses, however, are punctured usually after softening. Even old cases, with chronic suppuration and fistula formation, are sometimes remarkably improved under roentgen therapy, although much less readily than early stages."

In treating neuralgias it is well to remember that the etiology of the conditions so classified is manifold and that no one form of therapeusis can be successful with all. Excellent results have been secured by the author "in those cases where the pain is due to infiltrative lesions as a result of local inflammatory processes." Emphasis is laid on the fact that too intensive radiation will increase the edema and infiltration and, consequently, the pain. It is wise to adhere rigidly to small fractional doses, varying the skin-target distances, the filters and voltage. If two or three treatments do not afford relief, it is well to discontinue them, since the case would appear to be one not amenable to radiation. However, roentgen therapy frequently brings cure when other methods have failed, and it is well to give the patient the possibility of relief afforded by its use before recourse is had to surgical measures.

X-rays in the Treatment of Various Inflammatory Conditions. Simon Albert. R. I. Med. Jour., June, 1925, p. 90.

Nasal fibroma. — Nasopharyngeal fibromas are unique in that they are benign tumors, in the pathologico-anatomic sense, but their course is malignant because of rapid growth. They nearly always have an intrapharyngeal attachment and in all cases recurrences have ensued one or more months after operative treatment. The literature also shows that under operative treatment, one or more recurrences generally precede complete permanent cure, and that in nearly all the cases cited unusually profuse hemorrhages occurred. These tumors are distinctly most prevalent during adolescence and after the age of twenty-five years spontaneous regression generally occurs. This report is of a boy, aged 14, in whom both clinical and histological examination showed an angiomatous fibroma extending well to the posterior pharyngeal wall and obstructing any view of the right eustachian tube. Three months after the

surgical removal of the growth, examination showed a mass again encroaching upon the ethmoid region, but not extending back into the pharynx. Roentgenograms showed dense shadows extending into the ethmoid and also into the right antrum. The cell walls of the right ethmoid as well as the upper and inner wall of the maxillary sinus were destroyed or at least decalcified. Such bone destruction, without any evidence of repair, is almost characteristic of newgrowth. The roentgenograms, taken prior to the operation, showed no involvement of the antrum or ethmoids.

A series of radiation treatments was then administered by Dr. Pfahler, a detailed report of the dosage used being given in this paper. Two months after radiation had been started, the right maxillary sinus was entirely clear, though there was still some increased density in the right anterior ethmoid cells. A clinical examination of the nose and pharynx two years later showed no evidence of any return of the growth.

SOLOMON FINEMAN, M.D.

A Nasal Fibroma—Surgical Removal—Recurrence—Treated by Radiation. Benjamin D. Parish and George E. Pfahler. Annals Otol., Rhinol., and Laryngol., March, 1925, p. 219.

Osteomyelitis.—The reported cases of osteomyelitis of the cranial bones secondary to paranasal sinus operations are discouraging so far as successful management is concerned. Of twenty such cases, collected from the literature by McKenzie, there were no recoveries. Lillie reports two patients of his own, both of whom died. In one case X-ray examination of the head revealed extensive osteomyelitis of the frontal bone, nasal, malar, and left parietal, and a dense cloudy antrum. In the other case a roentgenogram of the head showed extensive destruction and thickening of all the bones of the skull. The lesions were suggestive of a syphilitic process in both cases. The writer emphasizes the gravity of osteomyelitis secondary to disease of the paranasal sinuses. The X-ray may show a picture quite typical of syphilis, but in association with sinus disease osteomyelitis must be suspected.

SOLOMON FINEMAN, M.D.

Osteomyelitis of the Cranial Bones Secondary to Paranasal Sinus Operations. Harold I. Lillie. Annals Otol., Rhinol. and Laryngol., June, 1925, p. 353.

Ossification of peroneal tendon.—A case is cited of ossification within the tendon of the peroneal at its attachment to the base of the fifth metatarsal. This was shown by X-ray as two calcified areas, looking like sesamoid bones. Removal of these by splitting the tendon resulted in complete recovery. When removed, the body appeared as a hard, semi-cartilaginous mass about the size of a bean.

W. W. WATKINS, M.D.

Ossification of the Peroneal Tendon or Sesamoid, in the Region of Its Attachment at the Base of the Fifth Metatarsal. Louis A. O. Goddu. Boston Med. and Surg. Jour., May 7, 1925, p. 899.

Effects of radiation.—The radiations from the sun contain heat, visible light and ultraviolet rays. Other rays, far more rapid in vibration, are produced by quartz mercury vapor lamp, the X-ray tube and radio-active substances. If all these radiations are arranged according to their wave lengths, we have the "electromagnetic spectrum." Wave lengths of light are measured in metric units, and if a scale is arranged showing the entire metric system of lengths, and the electromagnetic spectrum superimposed upon this, we will have a scale showing the accepted units of length, ranging from 10,000 light years to the gamma rays. If that portion of this electromagnetic scale which corresponds to the area of light waves is expanded, it will contain waves ranging from zero up to one micron in length. That portion of it which contains waves from about four to nearly eight microns in length are the visible rays. Within the ultra-violet sunlight area there is a restricted range of wave lengths which is not transmitted by glass, and it would appear from experimental work done at the State University of Maine on young chicks that this ultra-violet light in sunlight which is cut out by glass is essential to growth and proper nutrition. This is an important observation for the clinician, because important physiological processes in growing children are probably influenced by this same spectral band of light.

W. W. WATKINS, M.D.

Physiological Effects of Radiation—The Electromagnetic Spectrum. W. T. Bovie. Boston Med. and Surg. Jour., May 28, 1925, p. 1035.

Lung abscess.—This is an analysis of 227 cases, including 100 previously reported. The importance in etiology of operations upon the upper respiratory tract is even more striking in the last 127 than in the first 100. Tonsillectomy was responsible for 49 cases and tooth extraction for 21. In all, 113 cases, or 49.7 per cent, were traceable to aspiration of infected material from the upper respiratory tract. In 76, or 33.4

per cent, the onset was insidious and the cause undetermined.

The following are the cardinal indications in diagnosis: (1) *Cough and explosive expectoration:* The latter is uncommon and occurred in only 10 per cent. (2) *Foul breath and foul sputum:* These are quite common, but there are rare cases in which they are absent and their absence does not exclude pulmonary abscess. (3) *Dullness on percussion over a circumscribed area:* This is the most common single sign on physical examination, other signs being very variable. (4) *Elastic tissue in the sputum.*

Roentgen-ray examination. This is indispensable, though some caution must be observed in interpreting films taken at one sitting, not to mistake a partially resolved pneumonic process for abscess. Important conclusions regarding operability may be drawn from the radiographs. The site and extent of the process are better defined by roentgen ray than by physical examination.

Exploratory puncture is unnecessary and dangerous and should be condemned as a diagnostic procedure for establishing the presence of a pulmonary abscess.

W. W. WATKINS, M.D.

Certain Aspects of Pulmonary Abscess, from an Analysis of 227 Cases. Frederick T. Lord. Boston Med. and Surg. Jour., April 23, 1925, p. 785.

Pulmonary tuberculosis. — The application of roentgenology to the study of pulmonary tuberculosis is widely accepted as one of the most important diagnostic aids. The author bases his opinions upon the study of some 60,000 films of 8,700 subjects at the National Sanatorium for disabled veteran soldiers, in Tennessee. Fundamentally, he discounts the work of X-ray technicians without medical degrees and insists upon the highest standard of stereoscopic films. He reviews the anatomy, physiology, and pathology of the chest, concluding that to understand pathological conditions the physician-roentgenologist must clearly visualize the normal anatomical shadows. In the normal lung field, a faint, somewhat linear, interrupted, net-like configuration is to be found and all films must show this fine marbling. The latitude of normal variation is fairly wide and the thickness of the chest wall is an inconstant factor to be duly weighed. Also, the interpreter should be familiar with the shadows produced by pulmonary disease other than tuberculosis. One should remember, in making a prognosis, that the smallness of area of a lesion is no measure by which to judge; one must be prepared for almost any eventuality in the course of pulmonary disease.

Upon entrance, all sanatorium cases have the accessory sinuses X-rayed, and in a study of 1,400 of these cases definite conclusions have been arrived at as to the secondary effect on the lungs of chronic sinusitis. The author classifies the pulmonary effect of sinus infection at the head of the list of pneumopathies to be differentiated from pulmonary tuberculosis. The chest films of cases with sinus involvement show a definite clouding and multiplication of the lymphatics supplying the lower portions of the lungs. So characteristic are these basal appearances that subsequent X-ray of the sinus has been gratifyingly confirmatory. The X-ray appearance of influenza is characteristic. "The hilus striations and ramifications are firmly chalked into the film. This configuration is distributed evenly over both lung fields without predilection for any special region. These string-like shadows are not beaded, and consistently fail to subtend clouding or mottling in the outlying lung fields, unless, of course, associated with a tuberculous lesion, which is sometimes the case. The influenzal lesion coincides with the reticular anatomy of the lung. Pneumoconiosis has much the same even distribution, but there is a markedly accentuated density of these shadows within the confines of the central hilus. . . . Pneumonia produces a lobar density which is usually unmistakable. In tuberculous bronchopneumonia there is a soft, massive mottling, not necessarily confined to one or more lobes. . . . In bronchiectasis the hilus lymphatic trunks appear to be almost dilated within the hilus zone; the outer branchings do not gradually decrease in size, but appear to fade away rather quickly."

X-ray Diagnosis in Pulmonary Tuberculosis. R. S. E. Murray. Clinical Medicine, August, 1925, p. 515.

Pneumothorax. — Diagnostic pneumothorax is especially indicated in lung tumors, and when one has to differentiate an interlobar empyema. A bronchial carcinoma leading to atelectasis of an entire lobe of the lung gives a distinct roentgen-ray picture, which is easily confused with an interlobar empyema, especially if there is at the same time a thickening of the pleura. The complete separation of the lung from the pleura speaks for a lung tumor with secondary atelectasis of the lung, while extensive adhesions speak more for an interlobar empyema with pleural thickening.

Two cases are reported.

J. D. CAMP, M.D.

Diagnostic Pneumothorax. Harry J. Isaacs. Am. Jour. Roentgenol. and Rad. Ther., March, 1925, p. 250.

Diaphragmatic hernia.—All of the hernias reported were at the esophageal opening and generally behind the esophagus. They varied in size, the smaller ones being about the size of an English walnut and the larger ones as large as a grapefruit. In one case two-thirds of the stomach disappeared into the chest. The age of the patients varied from five to seventy-five years, the average age being about forty-five years. The percentage is slightly greater in hypersthenic individuals.

It is a comparatively simple procedure to demonstrate this type of diaphragmatic hernia if the cardia is filled with an opaque medium and pressure put on the diaphragm, by the patient taking a deep breath and holding it, or in the Trendelenburg position. With the patient supine and rotated in the left oblique position so as to get an oblique view, under the fluoroscope, the fundus portion of the stomach will be seen to pass above the diaphragm. Shortly after this the esophagus will fill. The column of fluid is from three to five inches high, and the esophagus seems a trifle enlarged. In all the cases, the cardio-esophageal opening was incompetent. The great difficulty in diagnosing a small hernia is that as soon as the cardia begins to empty there is a spontaneous reduction. In only four cases did the fundus remain adherent. The diagnosis was made on a single direct sign, the demonstration of a portion of the fundus containing the opaque medium above the diaphragm.

The symptoms of this type of diaphragmatic hernia present the widest variation. Most of the patients complain of vague discomfort or indigestion similar to the findings in chronic gall-bladder disease or ulcer, pain radiating to the back, often to the left shoulder, and gastric symptoms at night. A number have regurgitation in the morning, with hyperacidity, if they have been sleeping on the back, also slight substernal pain. A few have difficulty in swallowing.

J. D. CAMP, M.D.

Symptoms Observed in Fifty-three Cases of Non-traumatic Diaphragmatic Hernia. Thomas R. Healy. Am. Jour. Roentgenol. and Red. Ther., March, 1925, p. 266.

The patella.—During the past two years the authors have observed six cases in which the outer and upper quadrant of the patella consisted of a separated piece of bone. The separated bone tissue may consist of one or two fragments. These usually have a smooth outline and their periphery is cortical bone, which characteristics usually differentiate them from fragments of bone due to fracture. In five of the six cases the deformity was bilateral, therefore, in the presence of a suspicious bone deformity in the right upper quadrant of one patella, the other one should always be roentgenographed for comparison. If a similar condition is found, a positive diagnosis of a congenital anomaly rather than fracture should be made.

J. D. CAMP, M.D.

A Congenital Anomaly of the Patella. A. W. George and R. D. Leonard. Am. Jour. Roentgenol. and Rad. Ther., March, 1925, p. 271.

Treatment of cancer.—The author thinks it unlikely that a solution of the problem of the action of radiation on tissues will be arrived at for some years,—until we know more about the physiology and chemistry of the individual cells and their interactions. "The problems which have been called forth by radiation show us how little we know about the reactions inside the cells. The radiation itself is a means of studying these processes, and therefore it is of importance to medical science independent of its curative action." Radiation, however, has given us a new method of studying changes inside the cells. The author takes up the consideration of the several theories concerning the action of radiation on tissues and gives a brief review of the leading ones in such a way that it may be seen to what extent they agree with each other and with experimental results. He states, however, that it is "far from a complete review of all the literature in this field, and the references are restricted." As to theories in general and experiments undertaken to prove them, the author disgresses from his subject for a paragraph to make some wise comments. The writings of Rĕgaud, Wood, Murphy, and Kok, relative to the action of radiation on cancer cells, are discussed, as are those of exponents of theories which take into account the immediately surrounding tissues,—Woglom, Ewing, and Armstrong. "The stimulative action of radiation," he says, "is a mystery which has been utilized for much writing." Other experimenters have advanced the theory of a general influence on the body,—on the blood, organs, and glands.

Review of Theories of Mechanism of Action of Radiation in Treatment of Cancer. K. Wilhelm Stenstrom. Jour. Cancer Res., June, 1925, p. 190.

Technic for malignant neoplasms.—It is the author's belief that radiation therapy will better attain its purpose if the dosage is of such intensity as will give an impulse to the healthy tissues to react more vigorously against the

malignant cells. Such a dose is considered to be the "physiologic dose."

The constant factors in the technic employed are: 220 K.V., 4 ma., 50 cm. distance, through 0.75 mm. Cu. plus 1 mm. Al., portal 200 cm. sq. The variable factor is the time. When the glands of the neck are involved they are treated 3 or 5 minutes twice daily, for ten days or two weeks. Breast cases receive 5 or 10 minutes twice daily, over the supraclavicular region, anteriorly over the breast, and into the axilla for two weeks. If the mediastinum is involved it receives, in addition, 10 minutes' treatment daily, in an oblique direction from each side, posteriorly. Abdominal or pelvic lesions receive 10 minutes' treatment twice daily, during two or three weeks.

Soon after the beginning of the treatment nearly all of the patients experience a diminution of pain, and a feeling of wellbeing. This is followed by a shrinkage in the size of the tumor and a softening of its constituents. A section at this time will show a marked small round-cell infiltration. A section later will show, in addition, vacuolization of the cancer cells, loss of outline and staining powers and beginning hyalinization.

J. D. CAMP, M.D.

Further Observations on the Treatment of Malignant Neoplasms by a Fractional Roentgen Radiation Technic. Morgan, J. D. Am. Jour. Roentgenol. and Rad. Ther., March, 1925, p. 244.

Protection device. — The device described consists of a sheet of opaque rubber 18 inches wide attached to a heavy curtain roller at each end of the treatment table. After the patient is in place and the tube in position, the curtains are drawn over the patient and fastened beneath the tube holder. The device protects the patient from any stray rays and prevents him from coming in contact with the terminals of the tube or the high tension wires.

J. D. CAMP, M.D.

A Protection Device for High Voltage Therapy. George E. Pfahler. Am. Jour. Roentgenol. and Rad. Ther., March, 1925, p. 291.

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